

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY,
IN A
CONTINUED SURVEY
OF THE
WORKS OF NATURE AND ART.
IN THREE VOLUMES.

VOL. III.

JOHN GENTLEMAN

PHILADELPHIA

COURTNEY SURVEY



WORKS OF THE SURVEY AND ART

IN THREE VOLUMES

VOLUME II

THE
YOUNG GENTLEMAN AND LADY,
PHILOSOPHY
IN A
CONTINUED SURVEY
OF THE
WORKS OF NATURE AND ART;
By Way of DIALOGUE.

VOLUME III.

A SURVEY of the Principal Subjects of the
ANIMAL, VEGETABLE, AND MINERAL
KINGDOMS.

Illustrated by Nineteen COPPER-PLATES.

By BENJAMIN MARTIN.

L O N D O N,

Printed for W. OWEN, N^o. 11. near *Temple-Bar*; and
the AUTHOR, at his House in *Fleet-Street*.

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THE
YOUNG GENTLEMAN AND LADY

PHILOSOPHY

IN A
CONTINUED SURVEY
OF THE

WORKS OF NATURE AND ART;
BY W. D. DIALLOU.

VOLUME III.

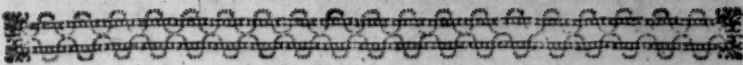
A SURVEY OF THE PHYSICAL SCIENCES OF THE
ANIMAL, VEGETABLE, AND MINERAL
KINGDOMS.

Illustrated by William Coster-Parker.

B. BENJAMIN MARTIN.

LONDON.

Printed for W. G. and W. J. at the Press of
the Author, at his House in Lambeth.
T. DIALLOU.



ADVERTISEMENT.

TO the general account given of this Third Volume in the Preface to Vol. I, the author has only to add, that though the multiplicity of subjects is very great, and the properties of most of them very singular and extraordinary, the reader may depend on the truth of the whole; there being scarce an article but what he has had, at times, in his possession, or immediately under his view, and critical examination: particularly those curious subjects which are represented as *presents* to EUPHROSYNE's *Museum*, he has now by him; and the numerous *microscopic* views here mentioned, he can repeat to any person. in a cabinet of uncommon variety of objects. In *hydrostatics* and *mechanics*, every experiment and instrument is so minutely and circumstantially described, that it is presumed they may be understood without a number of schemes and figures, which are very expensive, and not near so satisfactory as a plain and neat *apparatus* of instruments would be, which may be had of the author at a very easy rate.——To conclude, nothing further occurs to him materially necessary to initiate Young Ladies and Gentlemen into the *mysteries* of PHILOSOPHICAL SCIENCE; and he has only to hope, these his last labours, will be honoured with the same benign acceptance, as he has heretofore experienced.



THE HISTORY OF THE UNITED STATES

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TO THE GENERAL READER, I beg to inform, that the first volume of this work, which is now published, contains a full and complete history of the United States, from the first discovery of the continent, to the present time. It is a work of great utility and interest, and is calculated to afford the most accurate and complete information on the subject of the history of the United States. The second volume, which is now in the press, will contain a full and complete history of the United States, from the first discovery of the continent, to the present time. It is a work of great utility and interest, and is calculated to afford the most accurate and complete information on the subject of the history of the United States. The third volume, which is now in the press, will contain a full and complete history of the United States, from the first discovery of the continent, to the present time. It is a work of great utility and interest, and is calculated to afford the most accurate and complete information on the subject of the history of the United States.

OF THE
HISTORY OF THE UNITED STATES
VOLUME VI
CONTAINING
INSECTS: OF THE NATURE
KINDS, AND SPECIES, &c.

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OF THE
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THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART I.
CONTAINING
*A Concise SURVEY of the Principal Subjects of the
ANIMAL KINGDOM.*

DIALOGUE I.
*On Animal NATURE in General; and a short Ex-
PLANATION of the Animal OECONOMY, in respect
of the Human BODY particularly.*

Euphrosyne.

I Fear, *Cleonicus*, from some Items you have given me since our last Conference, that I must next exercise my Thoughts upon Subjects somewhat out of my Sphere, and beyond my Reach.

Cleonicus. Fear not, my *Euphrosyne*, Nature has placed nothing out of your Sphere or Reach, that is fit for a rational Being's Contemplation and Knowledge; indulgent Nature has made every Part of her wonderful Works, more or less, the most entertaining and interesting Employment of the human Mind.—The prone Brute regards only the Satisfaction of sensual Appetites; and though it be somewhat humiliating to consider that we also are obliged to support Life in the same manner, by *Eating, Drink-*

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ing,

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ing and *Sleeping*, yet it is a great Consolation to reflect, that the *Human MIND* is infinitely more exalted, and divine in its Nature, and capable of such a Degree of Thought, Reflection, and Reason, as is not to be found in any other created Beings that we know of.

Euphros. No Doubt, *Cleonicus*, but the Form, Fabric, and Faculties of Human Beings vastly excell those of all others; but in what does *Animal Nature* principally consist?

Cleon. In a *State of Sensation, or Perception, of Pleasure and Pain.*

Euphros. This seems so general a Definition, as to comprehend all those Bodies, or Beings, that have LIFE and Motion.

Cleon. You are right, my *Euphrosyne*, LIFE itself is nothing but the Continuance of such a *State of Sensibility*. When we cease to be sensible, we cease to live.—I have already shewn you that the Nerves are, by the all-wise Creator, made the immediate Organs of *Sensation*; and now I shall proceed to shew you the other great Operations in Animal Bodies, by which this divine Power of Life and Sensation is carried on, and continued to the destined Period of Existence in each—and these together make what is usually called the *Animal Oeconomy*.

Euphros. I long to hear you mention them, *Cleonicus*, for then I can better judge whether I shall be in any sort able to understand such unusual Kinds of Doctrine—therefore pray proceed.

Cleon. I will;—this great Affair of *Animal Life* is effected and continued by the Functions and Operations of certain Parts called *Viscera*, or, more properly, the *Organs of Life*, as they have been found disposed, and seated in the different Parts of the *Human Body*, particularly—They are as follow, (1.) RESPIRATION, or the Action of the LUNGS. (2.) The CIRCULATION of the BLOOD, which is effected by the Muscular Action of the HEART. (3.) DIGESTION of the Aliments we take in for the Nourishment of the Body; this is the Function of the STOMACH. 4. the SECRETION of different Sorts of Fluids, Humours, Juices from the Blood, &c. by those Parts, usually called the GLANDS.—While these great Functions are duly performed, the Animal enjoys a State of HEALTH; but when

when any of those Organs are impaired, or their Actions impeded, a Train of ~~diseases~~ Diseases follow.—But when the Action of any One of these Essential Organs ceases absolutely, then a *Cessation of Life* (viz. DEATH) must necessarily ensue.

Euphros. Oh, my *Cleonicus*! These are gloomy Speculations—but I recollect, there can be no good Music without Discords, nor any fine Painting without Shades and Glooms; so a Life mixed with Pleasure, and now and then a few Contrarieties, is certainly not so insipid, as one continued Scene of Pleasure would certainly be.—But to go on; I apprehend by *Respiration*, you mean no more than the common Action of *Breathing*.—

Cleon. Nothing more, my *Euphrosyne*; by *Breath* is meant the Air which we breath into, and out of the *Lungs* by the Passages of the *Mouth and Nose*; and it is with great Propriety and equal Sublimity, called in *Scripture*, the BREATH OF LIFE; because without Air we cannot live; but nevertheless, we are intirely ignorant what that *Principle of Life* is, which we draw in with our Breath, and are obliged so to do continually.

Euphros. Ah, *Cleonicus*! the poor *Rabbit* died a Martyr to Philosophy, that I might be fully convinced of the Necessity of Air for Animal Life.—But what becomes of this unknown Spirit, when it is got into the Lungs? for there the Air is divested of it, as I remember you proved by several Experiments on the Air Pump.

Cleon. The Air being forced through all Parts of the Lungs, by it's Pressure, in *Inspiration*, does there enter the infinitely small *Vesicles* or Bladders (which make the Substance of the Lungs) and by its Elastic Force expands them; over the Surfaces of these Vesicles, the Capillary Blood-Vessels are spread, and thus the Blood becomes some how or other impregnated with the Etherial Principle of Animal Life, which is, by this curious and wonderful Fabric of the Lungs, constantly applied, and by the *Arteries* circulated from thence, through all Parts of the Animal Body, for the Support of Life.

Euphros. I think from what you have said, *Cleonicus*, I can form a general Idea of this mysterious Affair of drawing Life with our Breath. But how is this Spirit

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transfused by the Circulation of the Blood through all Parts of the Body?

Cleon. The CIRCULATION of the BLOOD (which I mentioned as the second great Cause of *Animal Life*) is effected by the Mechanism and Action of the HEART; which noble Organ is contained in a thin Membrane called the *Pericardium*, of a Conic Figure, with its Base upwards, and its Point downwards, where it is fixed to the middle of the Diaphragm, which separates the *Thorax* or Breast from the Abdomen or Belly. This you may easily observe at any Time, when the Butcher (within a very few Doors of our House) is opening a Sheep just killed.

Euphros. I have often seen the Heart in the Case and Position you describe, in the Bodies of Beasts newly opened.—The Heart is, with many, a Tid-Bit, or relishing Repast—I like to eat it very well myself; but I should have more Pleasure in understanding the Use of it in the *Animal Oeconomy*.

Cleon. Because one Pleasure is *sensual*, the other *rational*;—In cutting the Heart open to broil it, you always observed larger and smaller Cavities within side of it; and Parts of large Tubes or Vessels which enter, or come out of it, on it's Top or Basis.

Euphros. I have observed them, but never had any Ideas of their Use, unless very imperfect Ones; should be glad therefore, if you would be at the Trouble of giving me a better Notion of them.

Cleon. I will with pleasure tell you all I know of them.—The two small Cavities above, are called *Auricles*, that is, little *Ears*; the two large Cavities, which make the Bulk of the Heart, are called *Ventricles*.—The HEART is a *Muscle* of a peculiar Kind; it has the Power of *contracting* and *dilating* its *Ventricles* in itself, for the Reception of the Blood on one Part, and the Expulsion of it on the other, into the proper Vessels which belong to it,—

Euphros. Is it not amazing, *Cleonicus*, there should be such Variety of Motions in the Heart, and exerted with so much Force, and we at the same time altogether insensible of it? So quietly is this great Work performed, that I should never have known I had a Heart, if I had not been told

told so, or seen it.—But how are the Functions of this wondrous Organ performed, *Cleonicus*?

Euphros. I will tell you as concisely as I can, my *Euphrosyne*.—The Blood, with the proper Nutriment, having been received from the *Left Ventricle* of the Heart, by that *primary Artery* called the *Aorta*, is communicated by it's infinite Ramifications to all Parts of the Body for it's Nourishment and Growth—afterward it is returned by a similar System of small *Veins* into those of a larger Size, and by them, at last, it is poured into that capital Vein, called the *Vena Cava*, which is inserted, and opens into the right Auricle of the Heart; and there constantly pours in the reffluent Blood upon every Dilatation of it.—In the Contraction of this Auricle, the said Blood is protruded into the *right Ventricle* below, in it's State of Dilatation.—From thence it is expelled, by it's Contraction, into the *Pulmonary Artery*, through all Parts of Lungs, to be re-fected or re-animated by the *Spirit of Life* in the Air, brought thither in Inspiration.—From these Arteries it is circulated, and returned through the *Pulmonary Vein*, to the *left Auricle* of the Heart in every Dilatation thereof.—Out of this Auricle, it is, in it's contractile State, thrust down into the *left Ventricle*, dilated to receive it.—Lastly, by the Contraction of this left Ventricle, it is forcibly driven into the *Aorta*, and, by a constant *Pulsation*, through all it's diminishing *Branches*, it is thence, as I said, distributed to all the most remote and minute Parts of the Animal Fabric.

Euphros. Pray, *Cleonicus*, how much Blood will one of those Ventricles hold, or throw out at a time?

Cleon. About *one Ounce*, my *Euphrosyne*, according to some *Anatomists*; but near two Ounces according to others;—so little is known, even of *Animal Oeconomy*, in this improved and enlightened Age!

Euphros. I suppose then it will be to no Purpose to enquire what Quantity of Blood there may be in the human Body?

Cleon. Indeed, my *Euphrosyne*, it will; for some Estimate it at a greater, others at a less Quantity; but the general Opinion is, that it amounts to about 25 Pounds Weight—And that the whole passes through the Heart ten Times

in an Hour, or once in *six Minutes*; and, of Course, the Heart *Beats* (as we say,) or produces a *Pulse* in the Arteries, about sixty-six Times in a Minute; but the *Pulse* *varies* with the different Temperature and Health of Bodies, and is therefore esteemed by Physicians, as a *general* (if not the *best*) *Index* of the latter.

Euphros. So I find; but pray, *Cleonicus*, why do you always talk of a *Pulse* in Arteries, but never mention any in the Veins?

Cleon. I need not tell you, my *Euphrosyne*, that there must be a *Pulse* in one, and none in the other, when you reflect that the Coats of the Arteries are very elastic, and that the Blood is forcibly propelled into the first and largest of them, in a very inequable Manner, in each Contraction of the left Ventricle of the Heart, which must Produce a Tide of Flood, and a Tide of Ebb (as I may say) in the Purple Torrent of that large Tube or pliant and elastic Vessel; the Flood distends and dilates the Artery, which again contracts at the Ebb; consequently an *alternate Beating*, or a constant *Pulse*, will ensue in the larger Arteries.

Euphros. I comprehend the Reason of all you have said, I believe, pretty well—but you say in the *larger Arteries*, which seems to imply, there is *no Pulse* in the *smaller ones*.

Cleon. I mean none in the least Degree sensible; for the Trunk of this great Artery, both upwards and downwards, is divided and subdivided into so many lesser Divisions and Parts, each of which is again divaricated, and ramified to such an infinite Degree, it is easy to conceive that as the Tide of Blood must also be diminished proportionably in each Subdivision of the Artery, it's impulse at length will be so far diminished, as neither to be felt or seen in the *Capillary Parts* of the Artery, not even in a Microscopic View, as I shall convince you ere long by an Experiment of the Circulation through one of the Toes of a Frog's Foot; where at the same time you will observe that the Stream is uninterruptedly continued round the End of the Toe in the same Canal, but only recurved, and then becomes a *Capillary Vein*, which with
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the rest return the Blood to the Heart, in an uniform Stream, without any Pulsation.

Euphros. You have placed this Affair of the Circulation and Pulsation in so clear a Light, as to render it intelligible with Pleasure.—I suppose you have little more to add on this Head, *Cleonicus*; and I think it high Time you are relieved.—

Cleon. Only one Thing more, my *Euphrosyne*, and I have done—pray look at this *Specimen of the Injection of the Blood-Vessels in the Skin of the Foot of a dead Youth*, and you will discover no Difference in the *Capillary State of Arteries and Veins*.

Euphros. Good Heavens, *Cleonicus*, what do I see! sure this is a strange, yea, an astonishing View of the human Skin, indeed!—Why, I can scarce stick the Point of a Needle between the Capillaries.—No wonder then, when I prick my Finger, a Drop of Blood will appear—We seem to be all Blood Vessels—What infinite Wisdom and Power appear!—How wonderfully are we made!

DIALOGUE II.

The foregoing SERIES of REFLECTIONS on the Animal OECONOMY continued; Of MASTICATION, DIGESTION, NUTRITION; Of the CHYLE, GALL, BLOOD, and other Fluids.

Cleonicus.

THE great Functions of the *Lungs* and the *Heart* in the momentous Business of *Animal Life*, we have already contemplated, my *Euphrosyne*; it now remains that we consider those of the *STOMACH* and *GLANDS*, by which *DIGESTION* and *NUTRITION* from the *Aliments* are procured, and proper *Fluids* secreted and supplied for that Purpose.

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Euphros.

Euphros. I believe very few People, as well as myself, know what is meant by Animal Digestion, or how it is effected; therefore I shall give the utmost Attention to what you shall say on that Subject, *Cleonicus*.

Cleon. I will endeavour to define, and represent it in such Terms, as shall make it very easy to be understood.— Know then, my *Euphrosyne*, that DIGESTION consists in the Reduction of the Food or Aliments into very small, fine and fluid Parts, chiefly by the Action of the Coats of the Stomach, the Humours therein contained, the Heat of the Body, and the Fluids and Juices secreted from peculiar Glands, brought thither to mix with the Fluid Aliments, and thus together they make what is called the *Chyle* or *milk-like Substance*, which then passes out of the *Stomach*, is absorbed by proper Vessels, to be further prepared for mixing and circulating with the Blood, in order to supply Nutriment to the several Parts of the Body.

Euphros. By the Account you give of Animal Digestion, *Cleonicus*, I should think the *Chewing of the Food* in the Mouth is a necessary Preparation thereto.

Cleon. You are very right in that Thought, my *Euphrosyne*, MASTICATION, or chewing the Food, is the very first Part of this great Process of Nature, and effected by the Agency of the Teeth; of which some are sharp-edged to cut the Aliments; some sharp-pointed, to pierce and penetrate the tougher Parts, and others have broad Surfaces, to grind them sufficiently small for *Deglutition*, or Descent into the Stomach by the Oesophagus.

Euphros. I further suppose, *Cleonicus*, that the Facility of swallowing our Food is not a little promoted by the Spittle mixing with it in Mastication.

Cleon. In this Point also, my *Euphrosyne*, you are happy in your Thought; for what you suppose is no less than a most indispensable Supply of Nature; the *Saliva*, or Spittle is not only necessary to dilute and attenuate the Aliments, whilst the Tongue turns and revolves them about in the Mouth; but it has a necessary Part also in the Grand Operation of *Digestion*; for these Reasons it is copiously supplied at the Time of Eating, by the *Salival Glands*, placed in great Numbers about the interior Parts of the Mouth, and of divers Sorts.

Euphros.

Euphros. But since NUTRITION is derived from the Aliments we take in, and they are diluted by the *Saliva* for passing into the Stomach, how comes it to pass, *Cleonicus*, that we have always occasion for such large Quantities of *Liquor* while we are eating, so that a Pint is but just sufficient for the most abstemious?

Cleon. That is on Account of *diluting the Aliments* sufficiently, as the *Salvia* is not one hundredth Part enough for that Purpose; for Digestion is a Natural Concoction of the Aliments to bring them into Chyle; just as you use a large Quantity of Water for concocting (or boiling) your Legs of Mutton over the Kitchen Fire, to render the Flesh fit for Mastication and Nourishment.

Euphros. Why, you descend to the *Kitchen Cleonicus*, for Elucidations of Philosophy, that is bringing it home to our Sex indeed.—

Cleon. You may think of *culinary Philosophy* as humbly as you please, yet I can assure you, that to explain all the natural Phænomena which the Scene of the Kitchen affords, would prove a Task not less arduous, than the Exposition of the *Solar System* was to Sir Isaac Newton.

Euphros. Hey Day, *Cleonicus*! I fear if you make yourself too familiar with *culinary Matters*, you'll set all our *Cooks* to studying Philosophy; and then instead of dressing our Viands they will be Philosophizing upon them, forsooth, and spoil them.—But let us ascend, to re-assume our Subject.—Pray, *Cleonicus*, how does this large Quantity of Fluids contribute so essentially to *Digestion*?

Cleon. The Particles of Fluids act with very great Force (by the Powers of *Attraction* and *Repulsion*) upon the Parts of Solids, and thereby divide and attenuate them to a requisite Degree for mixing with other Fluids and Juices, and to compleat the *Chylifications* in the Stomach.

Euphros. From all you have said hitherto, I think it is pretty easy to see the Cause or Reason of what we call *Hunger* and *Thirst*, *Cleonicus*; as One I take it, is the Natural Call for Aliments, and the other for Liquors to resolve them into Chyle.—

Cleon. I am glad to find, you have so clear an Idea of those common but most important *Appetites*.—And you are further

further to understand, my *Euphrosyne*, that the copious Draughts we take at our Meals, do also contribute much to *Nutrition*; for not only *October*, and *Old-Hock* will metamorphose the meagrest Mortal alive into a *Plump and jolly Bacchus*; but to my certain Knowledge, a Person may live upon *Water only*, for more than a *Week*.

Euphros, That must be hard Fare *Cleonicus*—But after the Food is duely concocted in the Stomach, where then does it go?

Cleon. By the Contraction of the Coats of the Stomach it is propelled thro' the upper Orifice (called the *Pylorus*) into the First of the Intestines, (called the *Duodenum*) where it is still further diluted by the *Gall* and *Bile* (separated from the Blood by the *Liver*) in one common Duct or Pipe, besides this, it is here still further attenuated by a fine Fluid, secreted by the Sweet-Bread (or *Pancreas*) called the *Pancreatic Juice*; by which, and the Bile, it is sufficiently fitted to enter the Orifices of very fine Vessels called *LACTEALS*, which discharge it into the vesicular Cells of the Glands, dispersed up and down the *Mesentery* (or *Crow*, as it is called in a Hog,)—From these Glands the Chyle is carried in a larger Sort of *Lacteals*, and poured into a Bag, called the *Receptacle of the Chyle*, (somewhat larger than a walnut)—Into this Bag, open also other extremely fine Vessels called *Lympha-Ducts*, and discharge therein into a *Lympha*, or Liquor clear as Water.—The Chyle having received here its final Dilution, is conveyed by the *Thoracic Duct*, up, through the Cavity of the Breast, to the left *subclavian Vein*, and there discharged to mix with the reflux Blood, as before related.—The superfluous solid Parts of the Food are by a wonderful Mechanism and *Peristaltic Motion* of the intestinal Tube urged forward for Discharge by Stool.—The great Quantity of Fluids we drink, is carried by Branches from the Trunk of the Aorta to the Kidneys, from the Glands of which it is secreted into the Basins in the Middle of each; and from thence by two slender Tubes called *Ureters*, it is carried to the Bladder to be discharged in Urine.—These great Operations of Nature, with some others, not unworthy your Notice, compleat the *Animal Oeconomy*.

Euphros.

Euphros. Well, 'tis all Wonder, all Mysterious, and all Conviction to me ! How is it possible there should be any such Monstrous Perversion of the Rational Faculties in any Man, as to stamp him with the Character of an *Atheist* But pray proceed, *Cleonicus*, to what remains that you think may become a Woman to know.

Cleon. You seem to have a strange Notion that Knowledge is limited by a *Distinction of Sex*, my *Euphrosyne* !—I don't know that Erudition is more a Sin or shame in *Women*, than it is in *Man*.—And satisfied I am, that the more a wise and virtuous Woman is versed in the Operations of Nature, the happier she must be.—

Euphros. A-done with your Nonsense, *Cleonicus*.—If any Thing of Importance Remains, be so good as to let me know it.

Cleon. The most stupendous and incredible Part of the *Animal Oeconomy* you have not yet been apprized of, my *Euphrosyne*.—I mean, *insensible Perspiration*.

Euphros. Indeed, I should have Thought, that the common Perspiration of our Bodies had been no such wonderful Matter, as you seem to represent it, *Cleonicus*.

Cleon. Will you not think it wonderful, my *Euphrosyne*, when I tell you that it is the greatest of all the Evacuations of the Animal Body,—yea, greater than all the Rest put together, by much.—

Euphros. I cannot conceive which Way you can make this out, *Cleonicus*.

Cleon. It is my Business now to inform you, Sister.—You must therefore know, that in the Skin there is an infinite Number of what they call *Miliary Glands*, which receive the Fine serous Parts of the Blood from the Capillary Arteries, and by proper Excretory Ducts, discharge it through the Pores of the Skin in a Manner, generally, insensible to us.—When this Matter very plentifully perspires, it becomes sensible in Drops of *Sweat*,—and when it is much diminished by partial Indraughts of cold Air, it makes the Disorder we usually call a *Cold*.

Euphros. I see *Health*, in a great Measure, depends upon a free Perspiration—but you have not yet shewn me how the Learned estimate the Quantity of it,

Cleon.

Cleon. That I shall do next, my *Euphrosyne*. *Sanctorius*, an Italian Physician, was the first who contrived a Method for this Purpose, which was by a *Statical Chair*, hanging at one End of a large Steelyard; in this Chair he sat and weighed himself accurately just before and after Meals, and also his Evacuations by *Stools* and *Urine*; and lastly, the Quantity of Perspiration that went off in stated Intervals of Time, *Sleeping* and *Waking*.—By this Means he found, that during a Night of Seven Hours Sleep, we Perspire about Forty Ounces, or Two Pounds and a Half averd.—By the larger Evacuations Twenty Ounces—in the whole about Sixty Ounces per Day.—He also further says, that if a Man eat and drink Eight Pounds per Day, Five Pound of it goes off by insensible Perspiration.—But that this is very unequable; for but One Pound was Spent in Five Hours from the Meal—from Five to Twelve, about Three Pound—from Twelve to the Sixteenth Hour, little more than Half a Pound. And many other curious Things you will find in perusing that Authors Aphorisms relative to this Subject.

Euphros. By what you have said only, my Ideas of these Things are greatly enlarged;—but, pray *Cleonicus*, can you see in the Microscope the fine Pores in the Skin, through which this subtle Fluid perspires?

Cleon. Indeed, my *Euphrosyne*, I never could see them, though I have frequently endeavoured it, with a Microscope that magnifies more than Three Thousand Times, and with much younger Eyes than *Leeuwenhoek's*, who first pretended to see them—however that you may judge and be satisfied by trying the Experiment yourself, I have procured a fine Piece of the human *Cuticle* for that Purpose, and placed it under the Microscope—there view it, Sister.

Euphros. I will, *Cleonicus*.—I see a beautiful Appearance of the *Cuticle* indeed,—it is extremely Transparent, but I see nothing like Pores, or little holes, in any Part—I am pretty sure too, there are none, but what are too small to be seen, though so very much magnified.—

Cleon. Do you observe any Thing like *Scales* upon this Piece of Scarf Skin, my *Euphrosyne*?

Euphros. Scales, *Cleonicus*, sure you are jocular, and want to make a *Gudgeon* of me—no, I see nothing like
Scales,

Scales, and God forbid I should.—If I saw *Scales*, I should hardly think myself a Human Creature—*Scales*! pray did you see any yourself *Cleonicus*?

Cleon. You seem quite alarmed, my *Euphrosyne*,—but you need not; 'tis *Poetry*, not *Philosophy*, that *Metamorphoses* People.—I can assure you, I never saw the Semblance of a *Scale* in the *Cuticle*, though the above-named Professor of Nature's *Arcana* constantly asserts there are such; and he has seen them often, though with *Old Eyes*, and Glasses of a *small magnifying Power* if compared with what you use.—The late ingenious Mr. *Baker* has given a Cut of those *Scales* as he found it, but never once says he ever saw them himself.

Euphros. Well *Cleonicus*, you have dispelled my Fears.—What I cannot see with my own *Eyes*, I will not see with *others*.—But to return to our proper Subject, what other great Parts of the Animal Oeconomy remain to be considered, *Cleonicus*?

Cleon. I have already mentioned the BRAIN as the Capital Organ of all Sensation, and from it the Nerves all originate.—I must now further observe to you, that the Brain is also the Seat or Residence of the MIND or SOUL of the Animal.—That it is the Grand *Emporium* of all Intelligence, and of all Ideas and Species of external Objects presented there by the Nerves.—Hence the Truth of the Axiom, *that nothing can exist in the Mind that was not first in the Senses*.

Euphros. If this be the Case *Cleonicus*, how come we by the Ideas of *Angels*, *Spirits*, *Apparitions*, and *Hobgoblins*? Since these are not *material Objects*, and therefore cannot affect the Nerves by Contact.

Cleon. You come by these Ideas, my *Euphrosyne*, as you do by those of the *Sphinx*, the *Dragon*, the *Chimera*, &c. they are all *Chimerical*, manufactured in the Mind by *Fear*, *Fancy*, and *Imagination*, by a monstrous Connection of the Ideas derived from real Objects; thus by the ridiculous Addition of *Wings* to the Human Form, we create an *Angel*.—A dead Corpse, we dress in a *Sable Shroud*, and thus make *Margaret's grisley Ghost*.—All our Notions of *Limbo*, *Hell*, the Devil and all his Works, are fabricated in the same Manner.—And when we collect the Ideas of
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all the mental *Powers* and Perfections into One, we form a faint Idea or Image of DEITY itself.—But *Fiction* is the Province of Poetry; too often practised by *****, but never by true PHILOSOPHY."

Euphros. I think these are what you told me some Time ago were *Metaphysical Subjects*, or above Nature, consequently, above my Comprehension: but, pray *Cleonicus*, is there any other Part of the Animal Fabric yet to be considered?

Cleon. 'Tis a very difficult Matter to find any End to these important Speculations, my *Euphrosyne*; The *Mamillary Glands* which secern the MILK in the Breasts, for Nourishing the Infant young.—Those appropriated for the *Continuation of the Species*.—The *Lachrymal Glands* which separate the *Tears*.—Muscular Motion little understood.—The Component Parts of the *Flesh, Bones, Fluids, &c.* are all Subjects of Importance though very imperfectly known.—One Particular however will entertain you in the Microscope at leisure Hours, *viz.* the curious *Configurations of Salts* contained in the different Humours of the Body, by evaporating a Drop of them on Glafs, and placing the Remainder under the Microscope.—I shall now give you an Experiment of this Kind in a Drop of the *Aqueous Humour* of the Eye.—Behold it my *Euphrosyne*.

Euphros. A beautiful Sight, indeed! What feathered and Fern-leaved Figures are there, and how infinitely numerous! How would the QUEEN OF SHEBA have been transported with such pleasing Sight, and what would she not have given for a Microscope, had she known its use?

Cleon. I knew you'd be delighted with the View.—You will see the same in the Vitreous Humour in a Tear, and in a Drop at the Nose, in the *Saliva*, the Sweat, and all other Fluids and Juices of the Body.—But our Time is expired, so, for the present, adieu my *Euphrosyne*.

DIALOGUE

DIALOGUE III.

Of the KINDS and SPECIES of ANIMALS;
 A short SURVEY of QUADRUPES; Of MON-
 KIES; Of the ELEPHANT, and RHINOCEROS.

Euphrosyne.

AFTER we had finished our last Discourse on the *Animal Oeconomy*, you told me *Cleonicus*, my next Entertainment would consist in a short SURVEY of the KINDS and SPECIES of Animals, and in particular, the Nature, and Differences observable in *Quadrupedes* from what we find in the Human Frame.

Cleon. That is my present Purpose, my *Euphrosyne*; and I think it will be very *a propos* to prelude my Reflections on this Subject, by those famous Lines of VIRGIL, describing the Origin of the World, and all created Beings in it.

*Know first that Heaven and Earth's compacted Frame,
 And flowing Waters, and the starry Flame
 And both the radiant Lights, one common Soul
 Inspires and feeds, and animates the whole.
 This active Mind infused through all the Space,
 Unites and mingles with the mighty Mass.
 Hence Men and Beasts the Breath of Life obtain,
 And Birds of Air, and Monsters of the Main.
 The ethereal Vigour is in all the same,
 And every Soul is fill'd with equal Flame.*

Euphros. I am charmed with all such Passages I meet with in Virgil, but with none more than this, which seems to be a Poetical Epitome of the Mosaic Account of the Creation.—But please to proceed, *Cleonicus*.

Cleon. Some Naturalists make three general Kinds of Animals, viz. (1.) Those which are the proper Inhabitants of the Earth, as *Man*, *Quadrupedes*, *Insects*, and *Reptiles*. (2.) Those whose proper Element is the Air, as *Birds*, and the winged Tribe of every Description. (3.) The Animals which live in Water, as *Fishes* of innumerable

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merable Species ; and other *Animals*, and *Animalcules* a many.

Euphros. I observe you have given the Preference to Man, and certainly with Justice, since Nature has done the same, making him *Lord over all the Creation*.

Cleon. It is true, my *Euphrosyne*, and you may with as good Reason (if not better) think yourself *Lady over all the Creation*; but notwithstanding this boasted Dignity of Human Nature, if you were to see but a Spider on your Bosom, how would you be terrified at so contemptible an Animal?

Euphros. You almost make me shudder at the mention of it, *Cleonicus*;—I remember in Baker's *Universe*, at the Sight of a Tyger, *The Monarch flies*.—And the witty Gay, (my favorite Author) had almost forfeited my Esteem, by making a FLEA of more Importance than MAN, because he fed upon him.—Says MAN

—————*Of what vast Consequence am I!*
Not of the Importance you suppose,
Replies the FLEA upon his Nose,
Created only for our Need,
That more important Fleas may feed.

Cleon. And yet perhaps, my *Euphrosyne*, you may think the Dignity of Man has never been so much degraded as by Dr. *Linnaeus*, who classes *Mankind with Monkeys*, or makes *Men* to be the first Species of the *Monkey Kind*.—And yet this Man was reckoned the *Æsculapius* of the present Age.

Euphros. Why truly, *Cleonicus*, this Doctrine is very humiliating;—strange, that Mankind should have subsisted so many Ages to be made *mere Monkeys* of at last!

Cleon. You make a very just Stricture on such a bold Assertion, my *Euphrosyne*.—Yet, it is probable, there may be a greater Affinity between the Nature, Form, and Parts of a *Man and a Monkey* (of the most perfect Sort) than you could wish to be convinced of.--For Instance, *The OURANG-OUTANG* is an APE of a superior Class—has no Tail—walks erect on its hinder Feet—its Face bare—its Forehead, Eyes, Nose, Chin, &c. greatly resembling the human Form

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—it has upper and lower *Eye-lids*—and *Eye-lashes* upon both—the fore Part of its Body quite *naked*—but *hairy* behind—the *Ears* exactly like a Man's—the fore Feet have *Fingers* and *Nails* like the human—the hind feet have *Toes* and *Nails* the same—the *Belly* and *Navel*, human—a *Skeleton* quite the same with that of a Child three or four Years old—and in its actions so similar to our own, that it is quite astonishing to observe them.—

Euphros. Pray, *Cleonicus*, have any of these strange *Monkey-Men* been ever brought to England?

Cleon. Yes, my *Euphrosyne*, several; about Forty Years ago an *Ourang Outang* or *Chimpanzee*, was shewn publicly in LONDON.—This Creature was near Three Feet high—walked upright about the Room—was cloathed in a loose Gown—had a Walking Stick in its Right Hand—and with its left, would take of its Cap, and make a Bow to the Company—it would also take a Basen of Milk off the Table, and respectfully drink to them—it would uncover any Part of the Body when bid—and when it slept, would lay its Head on the Bolster, and cover itself with the Bed-Cloaths—it died, and was dissected by *Dr. Tyson*—and its *Skeleton*, perfectly human, is now in the *British Musæum*.

Euphros. Upon my Word, *Cleonicus*, I am startled at what you relate—I know not what to make of myself.—An *Ape*, a *Baboon*, a *Monkey*, at last!—Oh my Stars!

Cleon. Nay, don't be out of Conceit of yourself, and make worse of the Matter than it is, my *Euphrosyne*; we are neither *Baboons* nor *Monkeys*, for they have all *Tails*, and we have none.—The Accounts of *Pygmies* and *Satyrs* amongst the Antients, undoubtedly arose from the *Apish Tribe* now mentioned.—It was not many Years ago, that a *Pygmy*, or *Dwarf Man*, was shewn here; a Native of Wales, about three Feet high,—who attained to an adult State or Manhood, at about eight Years of Age—grew old and gray headed at twelve.—His Face of an *Apish Form*, and full of *Wrinkles*—but had all the Faculties of the Human Mind.—On the other Hand, I have seen a Man so tall, and his Wife so short, that when he stood astride, she could walk upright between his Legs. But this *Giant* is much exceeded by others we read of.

Euphros. A strange Contrast indeed ! I had never been used to consider ourselves as such an odd Medley of Mortals.—I used to think it a Compliment, which POPE made to Sir J. Newton in making him a *Celestial Ape*, in these so much celebrated Verses.

*Superior Beings when of late they saw
A Mortal Man unfold all Nature's Law,
Admired such Wisdom in a human Shape,
And shewed a NEWTON as we shew an APE.*

But I did not know, till now, that he really was an Ape.—

Cleon. I find you are not a little deranged, my *Euphrosyne*, by Linnæus's Metamorphosing Mankind into Monkeys.—We will, therefore, now advert to another Species of *Quadrupedes*, which will prove a more agreeable Subject, and in the highest Degree excite your Admiration ; I mean the ELEPHANT.

Euphros. I have heard of such a wonderful Creature often, but never saw one ; have you *Cleonicus* ?

Cleon. Yes, my *Euphrosyne*, about twenty Years ago.—There is scarce any Thing in this Animal, but what is peculiarly amazing : As (1.) His enormous Size or Bulk. (2.) His wonderful PROBOSCIS, or TRUNK. (3.) His prodigious TUSKS, or Teeth. (4.) The Manner of the Females suckling her Young. (5.) The unparalleled Strength of this Creature ; and (6.) Its great Docility and Tractability.

Euphros. Pray *Cleonicus*, is not this the largest Quadrupede in the World ? I should conclude so by what you say of his Size.

Cleon. It is, my *Euphrosyne*, the largest of all others ; being fifteen Feet high, when full grown ; and some write of Elephants from fifteen to twenty Feet high.—The Length of the Body is not so great in Proportion.—The Skin is without Hair, full of Scratches, and Scars.—Its Tail has a Tuft of Hair at the End, as thick as Hog's Bristles.—The Ears are large, and hang down.—The Eyes are small for his Bulk.—The Body is round and full—and the Back rises in a Sort of Arch.

Euphros. But you say nothing of his Snout, *Cleonicus*.

Cleon. This is nothing more nor less than his stupendious Trunk, which runs out from his Head to the Length of
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six or seven Feet, and can be contracted to one.—It lessens gradually to the End—where it has *two Holes* or Nostrils—this Trunk consists of a fibrous fleshy Substance with Rings and Ligaments round it, by which it can be moved and turned every Way.—With this Trunk, by Help of a pointed Gristle at the End, he takes any Thing from the Ground, and carries it to his Mouth—his *Food* is Grass, Herbage, Grain, Flesh, and almost every Thing the Earth produces—with this Trunk he strikes with incredible Force; will Grasp a Man, and throw him up into the Air, &c.

Euphros. Well, these Feats are as wonderful as the Creature by which they are performed.—But what Sort of *Teeth* has this Prodigy of Nature, *Cleonicus*?

Cleon. It has no *Fore-Teeth*, but very large and strong Grinders, near two Inches square each.—But its two *Canine Teeth* or *Tusks*, are a Prodigy of Prodigies.—They grow to the Length of seven or eight Feet—and weigh upwards of one hundred and fifty Pounds each.—Their Substance is commonly called *Ivory*.—You have seen them stand at the Shops of *Ivory Turners* in the City, my *Euphrosyne*.

Euphros. I have, *Cleonicus*, many Time, but I used to think they were the *Horns* of some large Out-landish Animal.—How can the Creature possibly move with such a Weight upon it's Head!

Cleon. By a strength equally wonderful.—But a fourth Peculiarity in this Quadrupede, my *Euphrosyne*, which I mentioned to you, is the Mode of the *Female's suckling her Young*, which is this.—The *Udder* is placed forward upon the Body, nearly between the two Fore-Legs.—Then turning her Trunk to the Teats, she sucks out the Milk, and fills therewith the two long Canals contained in it.—After this she turns her Snout to the Young, and pours the Milk into its Mouth.

Euphros. A singular Method of *Suckling*, indeed!—You also mentioned the *Strength* of the Elephant, as very extraordinary, *Cleonicus*.

Cleon. This you will not wonder at, my *Euphrosyne*, when you see his *Skeleton*, and contemplate the enormous Size of his Bones.—The Emperors of the Eastern World

place pompous *Pageants* upon their Backs, and Ride in the most lofty *State*, surrounded and attended by their *Grandees*, on Hundreds of others, richly caparisoned and ornamented.—They are also used to carry a Sort of *Castle* on their Backs, in Time of War, with several Military Men in it.—Also for Drafts, and Burthen of such Weight as no other Animal is competent to.—They have been used as Executioners of Malefactors, and Captives, by treading upon them with all their Weight, and throwing them aloft in the Air with their Trunks.—Their Sagacity, Docility, and Tractability, is almost incredible in History, in regard to *Military Discipline* and the *Arts of War*.—I cannot give you a better Idea of this wondrous Animal than what the facetious GAY has presented you with in these Lines.

*Who doubts that Elephants are found
For Science and for Sense renown'd?
BORRI Records their Strength of Parts,
Extent of Thought, and Skill in Arts;
How they perform the Laws Decrees
And save the State the Hangman's Fees;
And how by travel, understand
The Language of another Land.
Let those who question this Report,
To PLINY's ancient Page Resort.*

Euphros. Well, *Cleonicus*, my Curiosity you have most agreeably satisfied, with regard to the Elephant.—I have heard of another extraordinary Creature, called the RHINOCEROS, what Account can you give me of that Quadrupede?

Cleon. I have seen one of them also; they are of a huge Size, almost as big as an Elephant, but their Legs not so long in Proportion.—It has a thick strong Hide, with Plaits which fold over one another, like a Coat of Mail, and so hard, as to be almost impenetrable.—It goes forwards with great Strength and Speed, but turns side-ways very slowly.—It has a Head somewhat like that of a Hog, but longer, after the Rate.—But it's most distinguishing Character, is a large strong solid Horn upon its Snout; by which

which it plucks up the Roots of Plants, Shrubs, and *Trees*, for Food.—By this Horn it can goad the Elephant, and kill him; also that it can therewith toss a *Wild Bull* into the Air.—Their native Climate is in or near the *Torrid Zone*, in all Eastern Countries.—The Flesh of this Beast is esteemed a great Dainty by the Dutch at the *Cape of Good Hope*.—In *Abyssinia*, they use them to Work, as we do Oxen—then kill and eat them.—But after all Description, my *Euphrosyne*, you will get the best Images of these enormous Creatures, by Viewing their *Forms* in a *Copper Plate Print*.

DIALOGUE IV.

The SURVEY of QUADRUPEDS continued; Of the BUFFALO, CAMEL, DROMEDARY, LION, TIGER, LEOPARD, LYNX, HYÆNA, BEAR, WOLF, FOX, HEDGE-HOG, &c.

Cleonicus.

IN pursuing our Survey of Quadrupedes, according to their *Sizes*, we shall find, my *Euphrosyne*, the next which occur will be the *Buffalo*, the *Bull*, the *Camel*, and the *Dromedary*.

Euphros. And pray what is that you call a *Buffalo*, *Cleonicus*?

Cleon. It is of the Bull-Kind, but a little larger than a common Ox—of a very wild and terrible Aspect, from its large Head, very broad Forehead, and fierce Wall Eyes—long, broad, and pendant Ears—short, but very strong Horns—extremely thick and deep in the Neck, Shoulders, and Breast—their Milk is excellent—When tamed, they use them to carry *Burthens*, to draw, &c.—And of their Hides is made that most useful Sort of Leather, called *BUFF SKIN*.

Euphros. I thank you, *Cleonicus*, for your Information concerning this horrible Creature.—Please next to acquaint me a little with the Nature of *Camels* and *Dromedaries*.

Cleon. The Camel differs but little from a Dromedary, excepting that the Camel has but *one Bunch* upon its Back, and the Dromedary has *two*.—I have seen both, my *Euphrosyne*.—They are about the Size and Height of a Horse—rather longer in the Body;—the Neck also longer, and bowed down,—then rising again with the Head in a Horizontal Position—is *Cloven-Footed*, like an Ox—and his Body is covered with a fine *Fur* or *Hair*.

Euphros. It is this Animal I find by what you say, *Cleonicus*, that I am obliged to, for those fine *Hair-Pencils*, with which I colour my Landscapes and Perspective Prints.

Cleon. It is so, my *Euphrosyne*; but the great and special Purpose of Providence in the Creation of this Sort of Animal, was to accommodate the Inhabitants of the Torrid Zone with a proper *Beast of Burthen* of a peculiar Form of Body, great Strength of Parts, and patient of *Hunger and Thirst* to an amazing Degree; by these Qualities they are fitted to traverse the extensive Sandy Deserts of *Asia and Africa*, which no other Beasts could do. Hence they are employed by Merchants, in large Companies called *Caravans*, to transport their Merchandise from *Bossora* to *Bagdat*, and from thence to the Ports of the Levant. They are also employed, in great Numbers, in the Pilgrimages of the Christians from *Aleppo* to *Jerusalem*; and by the Mahomedans, to *Mecca*, the City of their *Prophet*.

Euphros. Pray what Weight may they be able to carry, *Cleonicus*?

Cleon. The stronger Sort will carry from six to eight Hundred Weight, the weaker in general from five to six Hundred Weight. And so competent are they for such journeying, that they will travel eighty, ninety, or a hundred Miles a Day, when there is a Necessity for it.

Euphros. But pray, *Cleonicus*, how do they get Provision in those long and lonesome Deserts?

Cleon. You know, my *Euphrosyne*, that to Omnipotence, nothing is impossible. It has supplied this Creature with no less than four Stomachs, one of which was found by the *Parisian Anatomists* to contain thirty Cavities like Sacks, placed between two Membranes, which induced them to think they were the Reservatories where

Pliny

Pliny saith, that Camels do a long Time keep the Water, which they drink in great abundance—to supply the want thereof in the dry Desarts, &c.—As to Food, they carry out much with them, and the Camels browse the Shrubs, when they can find any, as they go along the Desarts.—There are other Sorts of Camels in other Countries, which have no Bunch on their Backs, as no such vast Burthens or Travel is required of them.

Euphros. Well, *Cleonicus*, you have given me a most satisfactory Account of the Camel, pray what Species of Quadrupedes come next?

Cleon. Lions, Tygers, Leopards, and Bears, my *Euphrosyne*; to which we may add the Panther and the Lynx, for they are all of the Cat-kind, having Whiskers, and are Hare-liped, except the Bear.—They are all Beasts of Prey; of prodigious Strength, Teeth, and Claws,—fierce and Ferocious in the Highest Degree.—The Aspect and Face of a LION bespeaks Majesty and Superiority; and he is always reputed the KING of Quadrupedes—his Prey, generally, consists of the largest Sorts of Animals, as *Buffalo's*, *Oxen*, *Horses*, &c.—They are very Numerous in *Asia*, and *Africa*, but none in *America*.—near the *Cape of Good Hope*, is a large Tract called the *Land of the Lions*; and so strong are they, that in the Year 1707, one of them carried off an Ox of a moderate Size, over a Wall of a considerable Height.—But this Creature is no Stranger in England, since you may see it whenever you please at the Tower.

Euphros. I know they are there, *Cleonicus*, and I shall one Day or other, beg of you to accompany me thither, to see the formidable Sovereign. I suppose there are also most Wild Beasts you mention, as *Tigers*, *Leopards*, &c.

Cleon. There are many Sorts of Wild Creatures my *Euphrosyne*, which you may see without Fear.—And what will excite your Wonder, is, that the Lion has with him a little favourite Dog in his Den, which would not be Half a Mouthful for him in the Forest.—You will there also see those Gigantic CATS, called *Tigers*, *Leopards*, &c.—And when the Keeper feeds them, you will observe

with what Ferocity and Voraciousness they fall upon their Food and devour it.—

Euphros. I suppose in a like Manner, that my pretty *Tibb* will sometimes furiously Spring upon, and seize the unwary *Mouse*.—But, pray *Cleonicus*, did you ever hear or read of a *Tortoiseshell Leopard or Tiger*?

Cleon. I never did, my *Euphrosyne*; nor yet of a *Tabby* coloured *Tiger*; for though some *Tigers* are streaked with Black and White, yet it is not in the Manner of *Tabby*; and in general they are very irregularly Spotted with Black and White, but no Yellow to make a *Tortoiseshell* Colour.—The *Leopard* is remarkable for his beautiful round Spots, and is less than the *Tiger*.—I shall give you an Instance of the prodigious Strength of a large *Tiger*.—A poor Peasant in the *East-Indies* had a *Buffalo* fallen into a Bog, and while he went to his Neighbours for Assistance to get him out, there came a large *Tiger* that saved them that Trouble, for he drew him out by his own Dexterity and Strength; and when he had done, threw him over his Shoulder, as a Fox does a Goose, and was carrying him away, with his Feet upwards to his Den. However, as soon as he saw the People, he let it fall and ran away. But he had killed the *Buffalo*, and sucked his Blood.

Euphros. Wonderful Strength indeed! Well may a Man flie at the Sight of such a horrible Creature!—But pray *Cleonicus*, what is that Beast called the *LYNX*?

Cleon. It is of the Cat-kind, and much like a *Tiger*, only less, being about twenty Inches high, and twenty-four in Length—it is a very fierce and voracious Animal, and quick sighted to a Proverb.—It is very happy for Mankind, that all these dreadful Beasts of Prey, are themselves extremely affraid of Fire; and fly from it howling and roaring in a terrible Manner.

Euphros. You have largely expiated on the Cat-kind of Savage Beasts, pray which do you reckon of the Dog-kind, *Cleonicus*?

Cleon. Of these the principal are the *Hyæna*, *Bears*, *Wolves*, and *Foxes*.—The *Hyæna* is a fierce and furious Creature, attacks Elks, Does, Dogs, Men, and all other Animals it meets with—it is somewhat bigger than a Wolf—

Wolf—has a frightful Aspect—both the *Hyæna* and *Lynx* are Natives of cold Countries, as *Siberia*, *Russia*, *Norway*, &c.—They are sometimes brought to England among other *wild Beasts* for a Show.

Euphros. I should never have Courage enough to see such Shows *Cleonicus*; but I have seen that ill-favoured Creature the *Bear*, led about the Streets in a Chain—it shewed Tricks, walked upright upon its hind Legs, and in that Posture danced about; climbed up a Sign-Post, with other antic Gestures.

Cleon. This was a *Bear* that had been tamed, and trained up to shew pranks for Diversion; and was a Proof of the great Docility of these Animals.—But in *Lapland*, *Greenland*, &c. were they are wild, they attack a Man, hug him with their fore Paws against their Breast till they squeeze him to Death, then devour him.—The Bears in *Greenland* are very large and White.—They are said to Sleep the most Part of the Winter in Mossy Beds they make in deep Holes of the Rocks, and hide the Entrance with Branches and Boughs of Trees.

Euphros. I believe I have never seen a *WOLF Cleonicus*, pray what sized Animal is it? I have heard of it often as a very ravenous Creature.

Cleon. It is a Beast of Prey found in all Parts of the World—the Size of a large Dog—he is so very voracious that he eats the Flesh with the Skin, Hair, Bones, and all together.—His Prey is every living Creature that falls in his Way, from the young Tiger to the Dormouse, but tame Cattle is the chiefest Part of his Food.—He is a very cunning Animal—is sometimes tamed when taken young, and will then associate with Dogs—and lye by his Master as they do—it is said to live thirteen or fourteen Years—his natural Voice is a horrible Howling—his Eyes emit a frightful Glare in the Night—and is the greatest Nuisance in every Country but *England*, from whence they have been expelled for Ages past.

Euphros. I am glad of that, *Cleonicus*, as I should never have any Comfort if I lived in a Country abounding with Wolves.—But say, have we no Beast of Prey in *England*?

Cleon.

26 THE YOUNG GENTLEMAN

Cleon. Oh, yes, many my *Euprosyne*; to wit, the *Fox*, the *Pole Cat*, the *Weasel*, the *Stoat*, &c. of less note—but in respect of these, your Lambs, your Poultry, your Eggs, &c. are in much more danger than yourself.

Euphros. These are but petty Felons, *Cleonicus*, and seldom strike Terror but into Lambs, Geese and Chickens; they rob our Henroosts, 'tis true, and suck our Eggs, but I can forgive them all that, while they do not assail ourselves;—they must live as well as we.

Cleon. I am pleased with your Humanity, my *Euphrosyne*; but why then do you set Gins and Traps to catch and destroy them?

Euphros. Nature has made it necessary, lest we should be over-run with them, and so deprived of these dainty Viands ourselves.—There is another little mischievous Animal, you call the *Hedge-Hog*, which, the Maids say, very often sucks the Cows, as they lie on the Ground in the Field; if so they must be reckoned Beasts of Prey, and subdued, else they would soon ruin our *Dairies*, and we should have neither *Milk*, *Butter* nor *Cheese*.

Cleon. What your Dairy-Maids tell you, is Fact, my *Euphrosyne*.—But this Animal is very rare; and it is so well guarded by Nature against all danger and attack by sharp pointed Prickles all over the Body (except the Belly

AND LADY'S PHILOSOPHY. 39

DIALOGUE V.

The Survey of Quadrupedes concluded. Of the HORSE, the ASS, the OX, the STAG, the REIN-DEER, the MUSK-DEER, CIVET CAT, BEAVER, DOG, CAT, ERMINE, SABLE, MOUSE, &c.

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I fear such a tedious Narration upon British Subjects will tire your Patience my *Euphrosyne*; but it is so prolific a Field of Natural Philosophy, that I cannot well avoid Prolixity.

Euphros. I wish and hope you may not tire yourself first, *Cleonicus*.—When you find me weary in contemplating the wonders of Nature, you may think me no longer a rational Being.—Such *Texts*, and such *Sermons* will admit of no yawning but in those who were never designed for thinking.—Therefore please to proceed, and I shall be all attention.

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DIALOGUE

DIALOGUE V.

The Survey of Quadrupedes concluded. Of the HORSE, the ASS, the OX, the STAG, the REIN-DEER, the MUSK-DEER, CIVET CAT, BEAVER, DOG, CAT, ERMINE, SABLE, MOUSE, &c.

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Cleon. You animate my Endeavours much my *Euphrosyne*;—you may perhaps wonder that I have not yet said any thing of our own Country, of the more conspicuous and noble Sort of Beast—but you will recollect that we began with *Beasts of Prey*, and we will now conclude with a few Reflections on those who are in the most eminent Degree the Benefactors of Mankind.—I begin with the HORSE, which is the most noble, generous, docile, stately Creature in the World, and adds more to the Imperial Dignity and Pomp, than the Diadem itself.—What can compare to the Prancing Steed, richly caparisoned, trained to War, foaming in the Field of Battle, and rushing on the Foe?—The Eastern Monarch mounted on the stately Horse, is viewed in the highest Pitch of Glory! So universally useful is this Quadrupede, that it has been indulged to every Nation on Earth.—Nay, so great are the very mental Faculties of this Animal that they exceed, in some Respects, any thing in the Human kind; for Instance, if a Man walks out twenty or thirty Miles

Miles, over Heaths, Commons, Forests, Hills, &c. variously intersected with Cross Roads, and returns again in the dark Night, it is a Hundred to One but he looses his Way; but if he is on Horse-back, he has nothing to fear, for the Horse will, if you give him the Reins, infallibly return by the same Way he went out, though he had never been that Way before.

Euphros. Pray, *Cleonicus*, does he this by *Instinct*, or by a Faculty of seeing in the Dark?

Cleon. *Instinct* is a Sort of Occult Quality, my *Euphrosyne*; every thing an Animal does, is done by the Power of the Senses, or Faculties of the Mind. Now the latter must be the Case with the Horse, who can discern no more than his Rider in the Dark, that I know of.—The CAT is the only Creature celebrated for that Faculty—Puss is as certain of her Prey by Night as by Day.—Not even the Lynx itself can vie with her in this Respect—I will not affirm a Cat can see without any Light, for there is no total Darknests known to try the Experiments withal.

Euphros. I have often wondered at the Ferocity of this little tame domestic Tiger in seizing on the poor pilfering Mouse,—Alas, how wretched the State of *Rats and Mice*, who ever live in fear of their Lives! and produce no Benefit to Mankind.—Why then were they made, *Cleonicus*?

Cleon. Indeed my *Euphrosyne*, such Queries are more than I can answer.—But you do not ask the Reason why the Ox the Cow, the Sheep, or the Goat were made.—You know the Roast Beef of Old England—your Dairies of Milk, Butter, and Cheese Curd—and the Comforts of Woollen Cloathing are Reasons enough of their Existence,—besides the Ox is a *Beast of Labor*, and designed for the Yoke, and as such has been used by all Countries and in all Ages.—Even the Ass itself, contemptible as it is, is a Beast of Burthen, and of great Benefit to the Poor by its labor,—As also the Rich, by its Milk, to nourish them in a Decline.

Euphros. Why, in regard to Food, *Cleonicus*, Nature seems very indulgent, even to satiating the Voluptuous—for of what Use else are such Herds of Deer in every Country,

Country, but to furnish *Haunches of Venison* to the Tables of *Epicures*?

Cleon. Oh, my *Euphrosyne*, besides mere Luxury, the *Buck* and the *Dee* contribute largely towards the Necessaries of Life; witness the wonderful *branching Horns* of the *Stag* to the *Cutler*, and their *Skins* to the *Felt Mongers* for *Cloathing*.—But there are two particular Sorts of Deer, that are still more worthy of your Notice.

Euphros. And, pray what are they *Cleonicus*?

Cleon. The One is called the REIN DEER, a most remarkable Instance of Providence in *Beast of Draught*, as it is a Native of the frozen Zone and Climes adjacent, where Horses can be of no Use, by Reason of deep Snow which covers the Earth, *Rivers*, and *Lakes*, the greatest Part of the Year, as in *Lapland*, *Norway*, &c.—This Animal is the largest of the *Stag Kind*, having prodigious *Antlers* or *Horns* upon its Head, branched out in a wonderful Manner just above it.—These Branches are six, two of which bend forward over his Face, and four backwards, three on each Side; the longest equaling the Length of the Animal itself.—When the *Laplanders* go Journeys, they place themselves in *Sledges*, made Boat-fashioned, which being connected with the Deer, they take the Reins, bid the Beast go on, and 'tis incredible with what Celerity he bounds away over extensive Plains, Vallies, and Mountains of Snow, over Lakes, Rivers frozen, and covered with the same, to a great Depth.—The Master directs him with the Reins, and he will travel sixty or seventy Miles in a Day—he is very tame and tractable—browses chiefly on the Moss which he finds by scraping away the Snow with his cloven Feet.—This useful Animal supplies those wretched People with almost every Thing they want.—His *Flesh* is their Food—His *Skin* or *Fur* furnishes every Garment from Head to Foot; and with his *Sinews* they make Threads and small Cords, to fasten the Boards of their Sledges, and many other Uses.

Euphros. Well, this is a singular Proof of divine Consultation and Providence in Behalf of those who were doomed to these dreary abodes.—Now tell me, *Cleonicus*, what Sort of Deer the other is, you mentioned?

Cleon. That is called the MUSK-DEER, my *Euphrosyne*, and is without Horns; and produces that precious Drug

we

we call *Musk*, so good against all Nervous Complaints, as Fits, *Apoplexies*, *Madness*, &c. These Animals are found in *China*, *Tonquin*, *Tibet*, *Tartary*, &c.—It is contained in a Bag under the Belly, covered with fine Hair, about three Inches long and two wide—at the proper Time, they cut it off, tie up the Orifice very tight; and being bought up by the Merchant, is sent to all Parts of the World.—We read also of an *Oderiferous Roe-Buck*, and a *Musk-Bear*, but I imagine they are all the same Animal, as yet imperfectly known.

Euphros. I have a Box, *Cleonicus*, which about seven Years ago had Musk in it, and you'd be surprized to find how strong it smells of it still.—But now you mention Animal *Perfumes*, pray what Kind of Creature is that called the *Civet-Cat*? by its Name it should be that which produces *Civet*, a Perfume so well known to the *Beau-monde*.

. *Cleon.* It is so my *Euphrosyne*; but it is made more like a *Fox* or *Dog* than a *Cat*;—it is a spotted Animal, about twenty-four Inches from Head to Tail.—Both Male and Female have a *Civet Bag* in the hinder Part of the Body, but that of the Male is much the largest.—This Pouch is somewhat like that containing a Substance like *Tallow* in the *Badger*;—indeed the *Civet-Cat* and *Badger* are so much alike, as to be reckoned of the same Species.—As to *Civet*, it has now but very little Reputation as a Medicine.

Euphros. What other *Medicinal Animals* are there of Note, *Cleonicus*?

Cleon. One in particular, my *Euphrosyne*, remarkable not only for a most Sovereign Remedy it affords us, but upon many other Accounts.—We call it the *BEAVER*, about the Size of a *Dog*, with the Fore-Feet divided into separate Claws like a *Dog's*; but his hind Feet are *webbed* like those of a *Goose*, for swimming—for it is in some Measure an *Amphibious Creature*—and his Tail is of a fishy Nature, with real *Scales* of a hexagonal, or six sided Figure.—There are in different Parts of the World, different Kinds of *Beavers*—but those of *North America* are best known to us.—The Skins of this Animal make the most considerable Article in the *Fur Trade* carried on by

by the Hudson's Bay Company.—The *Caster*, for which this Creature is so much celebrated, is a Sort of Glands contained in proper Tunics or Pouches in or near the Groin of the Animal.—The Flesh is esteemed a delicate Food; but the Tail the greatest Dainty of all.

Euphros. I have heard a strange Report of Beavers building Houses by the Sides of Lakes and Rivers for their Winter Habitations; is this really Fact, *Cleonicus*?

Cleon. You may depend upon it for a certain Truth, my *Euphrosyne*.—They not only build Houses, but they proceed in such Work to a geometrical Exactness.—One of their Houses was measured, forty Feet in Diameter, and one hundred and twenty in Circumference, for they are precisely round.—It was eight Feet above Water, with an *Oval Dome* at the Top.—It stood on the Edge of a Creek, with a Trench dug round, nine Feet wide, and eighteen in Length—so the House was surrounded with Water, toward the Opening of the Creek, and left dry next the Shoar.—Two thirds of the Structure was out of the Water, in the upper Part of which each Beaver was allotted a Place strewed with Leaves to lie upon.—There was a Passage below to the Water for Bathing, fishing, and other Occasions.—They are so cleanly that no Filth was ever seen in their Houses.—A House in general will hold eight or ten or twelve Beavers, and some are much larger.

Euphros. A wonderful Relation, this! pray *Cleonicus*, can you give me any Idea of the Manner in which they build their Houses?

Cleon. Towards the End of the Summer they associate together in Multitudes for this Purpose—then in detached Parties, they go to cutting down Trees, by gnawing them round at the Bottom with their Strong and Sharp Teeth, till they fall to the Ground—then again severing the Body from the Boughs, they roll it to the Place intended, with their Fore Feet or Paws. Here they lay several of them together for a Foundation—Then loading their broad Tails with Lumps of *Earth, Clay, &c.* they draw it home, and nicely spread it all over the Trunks of the Trees.—Upon this Earth they place another Layer

of Trees—then another of Earth over that; and so on, till they have finished the Ground Work.—Then they fabricate the Wall, by setting long Poles, in a Circular Form all round the Foundation, which they interweath with Boughs and Twigs of Trees—and then plaister up the whole with large Quantities of Clay, Stones, Sticks, &c. so ingeniously, that not a Breath of Air can pass through.—The Trees they use for Building, as also the Bark and Leaves for Food, are mostly of the *Poplar Kind*.

Euphros. Well, *Cleonicus*, the Man may talk of his *Chien Savans* where he will, I am sure (by what you say) the *Beaver* is by much the greatest *Connoisseur* of the two.

Cleon. But if the *Beaver* excells the *Dog* in one Thing, the *Dog* excells him in another.—For what Animal in the World besides the *Dog*, my *Euphrosyne*, could follow his Master by the Scent through Crouds of People at a Fair, and find him at a House a Mile beyond? Yet the Experiment has been actually tried, and the Fact evinced.

Euphros. But, *Cleonicus*, before we leave the Subject of *Furs*, which make so rich and beautiful an Addition to the Articles of Dress and Furniture, both to the Ladies and Gentlemen, be so good as to tell me, in a Word, whence they come, and from what Animals?

Cleon. They come from all Parts of the World, my *Euphrosyne*, and from most of the Quadruped Tribe—from the *Leopard* and *Tyger* to the *Rabbit* and *Cat*.—And every Fur not naturally variegated with beautiful Colours, Spots and Stripes can be made to appear so by the *Furrier's* Art.—The *ERMINE* is a Sort of *White Weazel*, but you admire its beautiful Fur, which adds much to the Luxury of Dress.—The *SABLE* of *Siberia*, is an Animal of the Size of a *Cat*, but its Hair so fine, that the Skin (though all of one Colour, a *dark Brown*) is more prized than that of any other; particularly the *Tails* which are sold at an immoderate Price.—But see, my *Euphrosyne*, your favorite *Tib* has just now brought in a *Mouse*!

Euphros. O Lud, *Cleonicus*! where is it?—do take it away, for Goodness Sake.—

Cleon.

Cleon. Don't let a dead Mouse frighten you out of your Wits, my *Euphrosyne*, to the Disgrace of all your Philosophy.—It luckily gives me Occasion to observe to you, that the Fur of a Mouse can shew a more singular and beautiful Construction of the *Hair*, than is to be found in that of any other Animal—to convince you of this, I have placed a little under the Microscope, pray view it.

Euphros. A beautiful Sight indeed,—how curiously the Hairs are variegated through their whole Length, with light and dark Parts alternately—they are quite bespeckled therewith.—What can be the Purpose or End of such hidden Beauties in the *Hair of a Mouse*, *Cleonicus*?

Cleon. You may ask ten thousand such Questions, my *Euphrosyne*, before you find an *Oedipus* to explain them to your Satisfaction.—POPE says, *whatever is, is right*, whether you understand it or not—I shall conclude this Speculation on Brute Nature, with the following Lines of that admirable Poet.

*Nature to these, without Profusion kind,
The proper Organs, proper Powers assign'd;
Each seeming Want compensated of course,
Here with Degrees of Swiftnefs, here with Force;
All in exact proportion to the State;
Nothing to add, and nothing to abate.
Each Beast, each Insect, happy in its own:
Is Heav'n unkind to Man, and Man alone?*

DIALOGUE VI.

Concerning INSECTS: Of *their NATURE,*
KINDS and SPECIES; and their HEADS,
EYES, WINGS, LEGS, PROBOSCIS, &c.

Cleonicus.

I Know the general Prejudices, and even Aversion, which Mankind have to Creatures under the Denomination
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of INSECTS and REPTILES, but I consider my *Euphrosyne* as an Exception to the general Rule, as I know that is founded in gross Ignorance; and you, my dear Sister, have been better bred.——

Euphros. Notwithstanding your Compliments, *Cleonicus*, and the amazing Beauty of many of these Creatures, yet I must needs own, that I am very much terrified with the Sight of some of them, and others I would not touch for the World!—so little does Reason, and all my Philosophy avail me.

Cleon. Before we have done with our Survey of the *Insect Tribes*, my *Euphrosyne*, you will readily subscribe to the sentiments of the great Naturalist *PLINY*, who says, *we admire the turritigerous Shoulders of Elephants, the Necks of Bulls, the Rapine of Tigers, the Manes of Lions, when notwithstanding Nature is never more compleatly seen than in the smallest Parts of her Workmanship.*

Euphros. Common Reason convinces me of the Truth of his judicious Reflection, *Cleonicus*; as he that makes a Landau with Six Horses drawn by a Flea, is much more admired for his Art, than a common Coach-Maker.

Cleon. I see you have a very just Conception of the Matter, my *Euphrosyne*; therefore shall, with the greatest Pleasure proceed to a summary Review of the *Nature, Forms, Parts, Generation and Transformation*, of this variable Tribe of Animals.—And (1.) As to its Nature, it is an ANIMAL, or a Creature in which is the *Breath of Life*.—(2.) It has *Animal Motion*, in a much superior Degree than *Quadrupedes*.—(3.) Insects have *Animal Senses*, and Sensations of Pleasure and Pain.—(4.) They have a *Mind*, and *Mental Faculties*, in an amazing Perfection, many of them.—(5.) The *Limbs, Joints, and Articulations* are astonishing in every Species.—(6.) The Circulation of Blood, and all other Fluids (secreted by proper Glands) through *Nerves, Arteries, Veins, Lacteals, Lymphatics*, &c. beyond all Conception minute, and invisible by the greatest Magnifying Powers.—(7.) The transcendent finery and Beauty of the Parts of many of them, as we shall by and by see.

Euphros. Well, you have said enough already, *Cleonicus*, to excite in the Mind of any Person a magnificent Idea of

of the Divine Structure of these despicable Creatures, as they are usually deemed.—But what does the Name *Insect* literally import?

Cleon. To *insect* is to *divide*, or cut asunder, and these Creatures are so called, my *Euphrosyne*, because their Bodies seem, as it were, *insected* or divided in different Parts, generally three, *viz.* (1.) The *HEAD*.—(2.) The *Thorax* or *Breast*.—(3.) The *Abdomen*, or *Belly*. Each of these has its proper Organs and Vessels (as in *Quadrupedes*) for carrying on the *Animal Oeconomy*.

Euphros. This is evident at first Sight in the *Bee*, the *Wasp*, the *Flesh Fly*, &c. But in what Order do you class these Insects *Cleonicus*?

Cleon. I assure you, my *Euphrosyne*, the *FAMILY* of *INSECTS* is so extremely numerous, and so anomalous at the same time, that the *Naturalists* have always been puzzled to find any proper Method of classing them; for they change and vary not only their *Form*, but their very *Nature*.—The same Animal that is now an *Insect*, is, by and by, a mere *Reptile*,—and after that, neither *Insect* nor *Reptile*—nor indeed scarcely an *Animal* at all, in *Appearance*.—Some Insects are *Aquatic* as well as *Terrestrial*, and change from one to the other.—In short there is no End of enumerating the *Differences*, and various *Changes* they undergo.——

Euphros. I beg, *Cleonicus*, you will not perplex either yourself, or me, with minute Particulars that are merely of a *physical Nature*, but only those which convey a more conspicuous striking Idea of these Animals in general—that will suffice for me.

Cleon. Well then, my *Euphrosyne*, you must know that a principal singularity in Insects is, that their *EYES* are all fixed in their *Heads*, and not moveable, as in *Quadrupedes*, *Birds*, *Fishes*, *Serpents*, and all other Animals.

Euphros. You seem to imply that Insects have *more Eyes than two*, *Cleonicus*.

Cleon. All Species of winged Insects have but *two*, but all the different Sorts of *Spiders* have more, some *four* some *six*, some *eight*, as we shall see hereafter, when we examine them more nicely.

Euphros. O, *Cleonicus* ! I'll take your Word for any Thing you have to say about *Spiders*, without ocular Demonstration.

Cleon. Why should those ingenious and innocent Creatures strike you with so much Terror, my *Euphrosyne* ?—But to proceed, since the Eyes of Insects are fixed, they are supposed not to see Objects very near them, and therefore Nature has wisely contrived for them what we call their *Antennæ* or *Feelers*, which are seated in the fore part of the Head, and in most Species, they are so finely articulated, and minutely jointed through their whole Length, that they can be moved instantaneously in all Directions, to feel out every Sort of Object that may be near them all around.

Euphros. I fancy you mean those fine slender Parts, like moveable *Horns*, which we see in the Heads of Butterflies ; do you not, *Cleonicus* ?

Cleon. I do, my *Euphrosyne* ; those of the *Butterfly* are the most delicate and conspicuous of all others ; and their Structure the most singular—they consist of about twenty five Joints—they are covered with fine mealy Dust—have each of them at the End a protuberant or bulbous Part, that contains a clear *Liquor*, which I suppose, renders the Sensation of Feeling the most exquisite.

Euphros. I imagine those curious *Brushes* I observe on the Heads of *Gnats* of most Sorts, are destined for the same Purpose, *Cleonicus* ?

Cleon. They are, my *Euphrosyne*, only of a different Form.—Nature is infinitely variable in her Means for effecting the same Thing.—In the common *Chaffer*, these *Antennæ* are *lamellated*, or consist each of long thin *Plates* set together upon one common Stem, which they can expand and contract, as you do your Fan.—In *Flesh Flies*, and common *Flies*, they are not so discernable, being short and pointed.—In some *Scarabs* or *Beetles* they are enormously long ; as in the *Capricorn Scarab*, or *Goat Beetle*, in some of which, the *Horns* or *Feelers* are more than three times the Length of the Body.

Euphros. Pray, *Cleonicus*, what Number of Legs have Insects ? I observe in *Bees*, *Flies*, *Gnats*, &c. always Six.

Cleon. All winged Insects, without Exception, have that Number ; but all the *Spider Kind* have eight Feet or
Legs

The Antennæ of a GNAT.

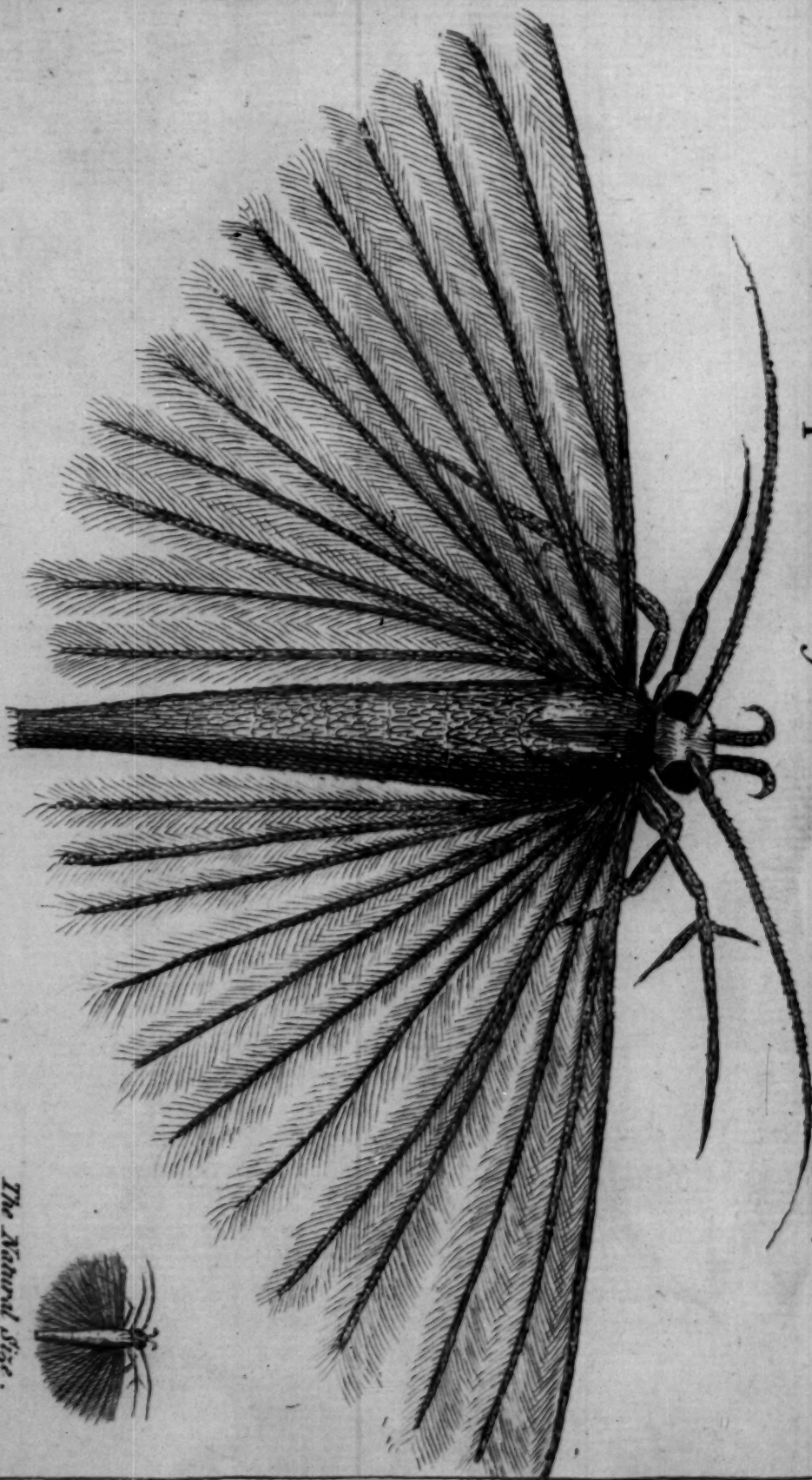


The Stings of a NETTLE.





A Microscopic View of the White Plumed Moth.



The Natural Size.

Legs.—Indeed a Spider is hardly to be reckoned a *proper Insect*; as it has no Feelers, no Wings; more Eyes, and more Legs; and their Heads join the Bodies.

Euphros. How many Wings have Insects in genera', *Cleonicus*,?

Cleon. Some have two transparent membraneous Wings, finely set with small hairs or Bristles over the Surface, and fringed therewith all round the Edges; as you see in common *Flesh Flies*, &c. in your Microscope.—Others have four membraneous Wings, two large and two small.—All the *Beetle Kind* have two pellucid Wings, most curiously folded up, and secured under two hard opaque Cases or Wings on either Side, called *Elytra*.—Many Tribes of Insects have no Wings at all, as *Spiders*, most *Ants*, *Earwigs*, &c. indeed the latter have something like *Half-Wings*, but they are never used in flying.—Lastly, all of the *Butterfly Kind* have four membraneous Wings, but made opaque by a fine mealy Dust, which comes off upon the Touch.

Euphros. This I have often experienced, *Cleonicus*, as also in Moths; but now it occurs to me, pray what difference do Naturalists observe between *Butterflies* and *Moths*?

Cleon. They observe no more than you do yourself, my *Euphrosyne*; they call the *Moth* a *nocturnal Butterfly*, as it shews itself very little in the Day, but mostly in the Evening, and Twilight of the Summer Nights.

Euphros. Is there any other difference in the Wings of Insects, *Cleonicus*?

Cleon. Yes, a very considerable one in the Wings of Moths; for some Species of them have *plumed* Wings, or such as consist of *Feathers*; and each Feather has its *Plumage*, as those of Birds.—And since they *fly with feather'd Wings*, they may be esteemed a Connection of the two *Geniuses of Insects and Birds*.

Euphros. Pray, *Cleonicus*, what am I to understand by the Moths' getting into our Cloaths, and eating them?

Cleon. I'll tell you, my *Euphrosyne*; whilst the *Papilio* or *Butterfly* lays it's Eggs on the Leaves of Vegetables, the *Phalena*, or *Moth* (being often within our Houses) does naturally seek Woolen Stuffs, old Cloaths, &c. to deposit her Eggs in; where after a proper Time, they are

hatched into Vermicules or maggots, which make to themselves small Cases (*Thecae*) with Holes to put out their Heads; and in this State they eat their Way about in the Cloth, 'till they fill it full of Holes and spoil it.

Euphros. I had no more sense than to think it was the Moth itself that eat the Cloaths.

Cleon. You might think so, my *Euphrosyne*, and yet find yourself in very sensible Company.—But so great was your Mistake, that, in general, after the Moth has laid it's Eggs, it never eats any thing at all, but dies directly. This you may at any Time observe in the *Moth* of the *Silk-Worm*.

Euphros. I have often viewed that mealy Dust which cover the Wings of Moths and Butterflies, in my Microscope, and I find them larger than I expected—very uniformly shaped—neatly inserted, in the Membrane of the Wing, in rows.—I see also that the Spots, and different Colours of the Parts of the Wings, all arise from the Colours of these little Particles (or Batteaus as I may call them)—and what I have often wondered at, is, that I have seen in them all Colours, and Dyes, except *Green* and *Blue*, *Cleonicus*, pray what can be the Reason of that?

Cleon. Your Observation in general is true, my *Euphrosyne*; Nature has bedecked this favourite Insect with all the Pride of Colours and Dyes, as well as the richest Embroidery about the Wings, and the Head.—But some Colours, like some Vegetables, are the Produce only of warm Climates, where these two Colours, *Blue* and *Green* are stronger and more brilliant than any others.—Indeed, an Indian *Papilio* is an Instance of the most perfect Art of Colouring that even Divinity itself can produce.—I shall place under the Microscope a Piece of a Wing of one of those foreign Butterflies for your Inspection—but view it first with the naked Eye.

Euphros. A most lovely Blue, indeed, I never saw anything to equal it, *Cleonicus*; what is *Ultramarine* to this! What are the *Tyrian Dyes* compared to this *Cerulean*, I might say, celestial Colouring?

Cleon. I shall now place it before the Glass, in the Opake Microscope, where you will see it in great Perfection,

tion, my *Euphrosyne*,—there take it, and hold it up to the Light.

Euphros. I will.—Good Heavens, how noble a View is here! I see the Colour is wholly in the *Batteaus*, for where they are rubbed off, the Membrane of the Wing appears a fine golden Ground.—I observe some of the *Batteaus* are more intensely Blue than others.—Also, that each *Batteau* is itself covered with a sort of Dust which heightens the *Azure*, very much—and in different reflections of Light, I see different Hues and Purple Shades, as usual in our finest Satins.

Cleon. I will now give you an Instance of a Green Colour in the Wing of another exotic Butterfly, my *Euphrosyne*, which hold up to the Light as before.——

Euphros. I do.—I see the Green *Batteaus*, sure enough—but they are but here and there one, feathered, as it were, over the Surface of the Wing—these are a Green truly, in some, a little inclining to Yellow, but intensely bright in all.—I see now the Reason why it appears so beautifully speckled to the naked Eye.—I likewise observe each *Batteau* consists of nine or ten strait Lines or Filaments, which give it a very pretty Appearance.—The whole is a wonderful Sample of divine Power, Wisdom, and Design.

Cleon. And so is every Thing, my *Euphrosyne*, when well considered.—Another Part in this fine Creature will astonish you.

Euphros. O, pray shew me that, *Cleonicus*?

Cleon. First view the Head of the *Papilio*, my *Euphrosyne*, and there you observe about each Eye a round thin Brush of Hairs, with something that appears Brown at the Bottom between them.—Look at it with the bare Eye.—

Euphros. I do:—I see something of a roundish Form, but cannot tell what, *Cleonicus*.

Cleon. I'll shew you what it is instantly, my *Euphrosyne*; first, I separate the Head from the Body—then with the Point of this Penknife passed between the two bristly Ruffs, I take out that round Thing you saw in part—Behold now the whole of it upon the Glass.

Euphros. I see it *Cleonicus*; it seems to me like an Eel coiled round and round, when skewered for broiling.—I can tell six rounds in it.—Pray what do you call this Part?

Cleon. It is called the *Proboscis*, or, Trunk of the Butterfly, my *Euphrosyne*; and tho' you now see it coiled up in a small Compass, yet when it is to be used, the Fly has the Faculty of extending it out into a right Line, and of incurvating it in an any Degree required;—by this Means it can readily put it down into the *Honey Cups* of Flowers, and extract their *ambrosial Sweets*; for Flies, like fabled Deities, live on nothing else.

Euphros. Now you mention that, *Cleonicus*, I recollect that I have seen Butterflies often do this.—That Trunk seems to the naked Eye as fine as a Hair; but in the Glass, it appears as large as a middle sized Eel—and much of the same Colour, except at the End, where it appears Yellowish—but I think it appears also *double* at the End, pray is it really so?

Cleon. It is not only double at the End, my *Euphrosyne*, but through it's whole Length—and tho' the Creature has a Power of uniting both Parts very firmly, when it uses it, yet it can also divide it at the End, when collecting it's Food from the Flower—and both Parts seem to be tubular, or hollow, for conveying it to the Head—for there appears in Papilios no other Mouth but this fine Spear or Trunk.—This Part varies greatly in its *Form* and *Size* in the different Species of Flies, according to their various Modes of collecting and taking in their Food.—The common Flies upon your Tea Table, will afford a most wonderful and diverting Instance of this Kind, if you view them nibbling the Particles of Sugar, with the ENGISCOPE, I some Time ago gave you for viewing near Objects, at those in the *Room, Garden, &c.*

DIA-

DIALOGUE VII.

The SURVEY of INSECTS continued. Of the ELEPHANT-BEETLE; the RHINOCEROS-BEETLE; the STAG-BEETLE; BUTTERFLY; GRILLO-TALPA; GRASSHOPPER and LOCUST; Musk and Spanish FLIES; the Curculio, or imperial Brazilian SCARAB.

Euphrosyne.

OF all the Species of Insects, I should be glad to be informed, *Cleonicus*, which you find to be the largest?

Cleon. If you mean with respect to the *Body*, my *Euphrosyne*, the largest yet known are the SCARABS, which come from abroad; among these are, the ELEPHANT-BEETLE, said to be largest of all; from *Surinam*, the River *Oroonoko*, and other Parts of *South America*—it is of a Black Colour, covered with a hard shell-like Substance—four Inches in Length, two Inches and a Half wide—the *Proboscis*, or Trunk, is moveable at its insertion in the Head; is an Inch and Quarter long, and terminates in two Points but not perforated—it has two Horns, three Quarters of an Inch long, immoveably fixed, one on each Side of the Trunk.—It flies with great Force, and extent of Wings.—Besides this, there is another, nearly of the same Size, called the RHINOCEROS-BEETLE, whose Trunk turns up, but has no Fork at the End, which is here a sharp Point—The largest of this Sort come from *India*, though there are some in Europe more resembling a Rhinoceros in the Horn, but not so big.

Euphros. I really should be afraid to stir out of Doors of an Evening, if I were to live in a Country where such winged Monsters would be apt to worry me—for I remember

member, *Cleonicus*, when I have sometimes spent a summer's Evening in the Country, how I have been terrified with the Appearance, and now and then with a *Stroke*, from those they called a BUCK or STAG BEETLE, though they were nothing like the bigness of the others you mention.

Cleon. Indeed, my *Euphrosyne*, the *Stag-Beetle* is a formidable Figure, when it is not upon the Wing, but much more so, when it is—their two Horns branched like those of a *Stag* are more than an Inch, or Inch and Half long, when full grown—at the End of these are Nippers like *Lobster's Claws* almost, with which it can pinch and lay hold of any thing.—Besides these, there are many others of this Species, with strong Horns, but of less Size.

Euphros. These large Insects you have mentioned are all of the *Beetle* Sort, *Cleonicus*; but pray, are there not very large Butterflies also from abroad?

Cleon. The largest I have seen, has the Tips of its Wings, when fully expanded, at eight Inches Distance—I think we have none near so large in England.—The hottest Countries produce the largest, as well as the finest coloured Animals in general.

Euphros. But pray, *Cleonicus*, which do you esteem the largest of the English Insects?

Cleon. It is said, the GRILLO-TALPA, or MOLE-CRICKET is the largest Insect in these Parts of the World, if it may be fairly called an Insect.

Euphros. Why do you put in that proviso, *Cleonicus*?

Cleon. I will lay before you the Animal itself, my *Euphrosyne*, and then you will soon see the Reason of that Query.

Euphros. Good Heavens! *Cleonicus*, what Creature have you got here? I have never seen any Thing like it before—It appears in the hind-Parts like an Insect with short Wings, and Rings round its Body, like a Wasp or Bee—but on the fore Part I scarce know what to make of it.—It has a large and strong Case, or Coat of Mail over its Shoulders.—It has six Feet indeed, but only four of them like those of an Insect.—The other two fore Feet, have somewhat like Thighs, Legs, and Paws, with Claws somewhat like

The GRYLLOTALPA or MOLE-CRICKET.

Natural



Size



Magnified

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like those of a *Mole*, which I have often viewed with amazement, to see how wonderfully Nature has adapted every Part of Animals to their particular Way of Life.

Cleon. You are quite right in your Observations, my *Euphrosyne*; Nature has given this equivocal Animal, the two fore Feet of a *Mole* (in Latin *Talpa*) and partly its Way of Life, for it is a *subterraneous* Creature for the most Part, living chiefly *under Ground*; and therefore its palmated fore Feet serve for the same Purpose as to the *Mole*, viz. to dig Holes in the Earth, which it does with surprizing force, agility and celerity—by this Means as soon as any Danger is apprehended, it immediately buries itself *under Ground*, quite out of reach from the Enemy.—As to the four hinder Legs, if you remember those of a *Grasshopper*, (in Latin *Gryllus*) you will perceive in these a great likeness to them,

Euphros. I have often admired the hinder Legs, of a *Grasshopper*, as formed on Purpose for *leaping* with very great Strength—have taken great Delight in viewing their peculiar Mode of Motion, as I have walked on a Summer's Day through Fields of new-mowen Grass.—I now clearly see the Reason of it's Name of *Mole-Cricket*, for a *Cricket* I know is only a *domestic Grasshopper*, which Nature has fitted to our Fire-places, as it has *Swallows* to the Tops of our Chimneys—and pray, *Cleonicus*, is not this Creature another most evident Connection of the Quad-rupede, and Insect Kinds?

Cleon. most undoubtedly, my *Euphrosyne*; and they who can't see the peculiar Design of Providence in the Formation of this singular Animal, have very little Advantage of *Eye-sight*, indeed! And I question if they can Reason so well as the *Gryllo-Talpa* itself.—'Tis a melancholy Thing to observe with what seeming insensibility we regard the most *striking Proofs* of the Divinity, at the same Time that we most violently contend for its Existence by such falacious Topics as prove nothing at all.

Euphros. Too often true, *Cleonicus*.—But now we are upon the Subject of *Grasshoppers*, pray tell me why I meet with one sometimes, which is many times larger than the rest—I suppose I have seen them an Inch and Half long, and as big as my little Finger.

Cleon.

Cleon. These are properly the great Green LOCUST; for *Locust*, *Grafshopper* and *Cricket* are only different Orders of the same Species of Insects.—These *Green Locusts* are produced in some European Countries in such Numbers, that they devour all their Herbage and Corn; for they are a very voracious Animal.—But in foreign Countries they are much larger yet, and of a Brown Colour—in such swarms as darken the Sky—and when they light upon the Earth, they spread desolation all around by their rapacious Jaws.—On this Account they are upon Record as one of the *Plagues of Egypt*.—In the Eastern Countries they are generally esteemed the Instrument of divine Vengeance for punishing sinful Nations.—Not many Years ago a terrible Host of them made a descent upon England, and made great Devastations in many Places—and some think we have Reason to expect the same Scourge again soon.

Euphros. Oh, pray don't go to propheying, *Cleonicus*—I pray God to avert such Judgement in my Time! Pray let us call a new Cause.—You will please to let me know if the hot Climates do not inhanche the Beauties and Colours of Scarabs, as well as those of Butterflies.

Cleon. You will soon be convinced it does, my *Euphrosyne*, and perhaps in a higher Degree—for though we have many in *England*, and in all Parts of *Europe*, that are extremely fine and highly ornamented in every Part, with the richest Colours and Hues; and curious Workmanship in every Part of their Bodies, Wings, Legs and Feet.—Witness the MUSK FLY, with it's long and finely jointed Feelers—it's curious and variously coloured Head, and Back, and Wings, &c.—with Legs and Feet, in their Fabrication, equally remarkable.

Euphros. Pray, are not the *Spanish Flies* reckoned among the more curious Sorts of Insects?

Cleon. They are so, upon two Accounts, my *Euphrosyne*, for first they please the Eye by their beautiful Form and Colours, especially when viewed by the *Opake MEGALASCOPE*—and secondly, they give you as much Pain, by their *caustic Salts*, when applied to your Flesh in *Blisters*.—So that *Cantharides* are an Order of Insects that are of the greatest Service to Mankind, as they often save our Lives.

Euphros.

Euphros. I remember when I was viewing that Department of the *British Museum*, where INSECTS are deposited, I saw innumerable Instances of those most striking Forms and variegated Beauties of Creation.—But what I wondered at, *Cleonicus*, was, that many of the finest of those gaudy Objects, they told me were actually Natives of the *British Islands*.

Cleon. We certainly have many that make a glorious Appearance, and are richly ornamented in their several Parts, but they are not frequently to be met with, my *Euphrosyne*; I shall take you, one of these Days, to the Private Museum of a Member of the *Aurelian Society*, where you will observe an amazing Variety of the finest Butterflies, Moths, and Insects, all of our own Growth, that you can ever expect to see on this Side the Indies.

Euphros. In that you will infinitely oblige me, *Cleonicus*,—But I observe still, that if I will go to the *Indies*, I may there find much finer Insects.—Pray what are the highest finished Pieces in the *Insect Creation*, that you have seen brought from those Parts?

Cleon. We have always had very fine Insects from those hot Countries;—But lately, the finest of all that the *Indies*, or the *World*, can produce.—I have been favoured with a Present of One from a *West-India Merchant*, who brought it from the *Brazils*.—This is the Creature, my *Euphrosyne*—could you wish to see a finer?

Euphros. The Sight of it is astonishing! Silence only can express my Wonder! What is it infinite Power and Wisdom cannot do? Sure this Creature proves the EXISTENCE of a GOD, beyond any Thing in Nature besides.—We may find Words to describe the Glories displayed in the other Parts of the Creation.—But I think, *Cleonicus*, in this one Instance, they are utterly ineffable!

Cleon. I know it would throw you into Raptures, at first Sight, my *Euphrosyne*, as it appears to be set all over with *Diamonds*.—Nothing in the *Regalia* of the Tower, is one hundredth Part so glorious and resplendent.—I have contrived a Piece of Machinery, with a large polished

lished concave *Speculum*, on Purpose to shew you the whole Body of this wondrous Fly at once, at a pleasing Distance, and largely magnified.—There, look through that Hole, my *Euphrosyne*.

Euphros. I will, *Cleonicus*,—What a *Heavenly View* is this! If I had not known it was an Insect, I should have thought I had seen an *Angel* in that Form.—What numberless brilliant *Embossments* are here all over the Surface of the Wings, the Head, the Legs, &c!—sure they are composed of something analogous to *Rubies*, *Emeralds*, *Sapphires*, *Chrysolites*, and other Gems of the brightest Lustre.—It seems five or six Feet long—but pray *Cleonicus*, let me have a closer and more critical Inspection of this matchless Finery.

Cleon. You shall have your Desire satisfied in the utmost Degree, my *Euphrosyne*.—I have contrived a *Tambour Explorator*, which will give you a nearer and more perfect View of it, but only in Part;—it takes in the View of one whole Wing—behold its transcendent beauties.*

Euphros. O, wonderful View indeed! why I now see the several Parts of which each Gem (in common Appearance) is composed.—There is a great Number of shining Particles in every brilliant Stud.—They are a little like the Form of those bright *Batteaus* I saw in the Indian Butterflies Wing.—In them the Colour was the same throughout, but in these I see a Variety of Tinges in the same *Batteau*; and no two alike neither.—Well, but let me see them still more magnified, *Cleonicus*.

Cleon. You shall my *Euphrosyne*,—for which Purpose, I shall put on the *single Lens* which magnifies each *Bracteola* or *Batteau*, one hundred times in Length and Breadth—there, now view them, my *Euphrosyne*.

Euphros. I see them very large and distinct—they are a quarter of an Inch long, in Appearance—finely tinged with various Colours.—I observe they are placed in *Cavities* below the Surface of the Wing.—They altogether make a beautiful and resplendent Figure in each Stud.—But pray, *Cleonicus*, what are these *Bracteolæ* (as you call them)? are they opake or transparent?—they look somewhat like stained Glass.

Cleon.

Cleon. I shall dig a few of them out with the Point of a fine Needle, and place them in a Concave under the single Microscope—now view them, my *Euphrosyne*, and your Queries will be all solved at once.

Euphros. Oh *Cleonicus*, this is really beyond every thing!—I think them, in this View, the most noble Phenomenon the Colours of Light can exhibit.—They are transparent as Glass itself.—I suppose brittle too, for I see one broke strait across by the Needle in taking out.—The wonderful Dyes are not superficial, but penetrate their very Substance—and continue the same, but more or less vivid, in all Reflections and refractions of Light.—Pray how many of these little glittering Things are contained in each Cavity, *Cleonicus*.

Cleon. That Question I cannot readily resolve, my *Euphrosyne*.—They lie so thick one upon another, that you cannot number the whole at once.—They are fixed on short Pedicles over all the Cavity; and so firmly, that when I take off Impressions with *Isinglass*, but few of them loose their Hold, and come off with them.—However in this Way, they are best applied in the *Solar Microscope*, which will afford you an Opportunity, as you are Mistress of the Pencil, to delineate them upon a Paper Screen, to trace the Boundaries of the Colours in each; and afterwards to colour them exactly to the Life—and this I shall recommend to you for a delicate Amusement of some of your leisure Time.

Euphros. That I shall attempt the first Sun-shiny Day, as you furnished me with Materials, *Cleonicus*;—But after all, what is the Name of this splendid Insect?

Cleon. It is called the *Imperial SCARAB* of *Brazil*.—They say, that on a Sunny Day, it is almost impossible to look at them, when in swarms on the Wing, so great is the glowing glory of their various and heightened Colours?—If *SOLOMON* in all his Glory, could bear no Comparison with that of a *Lily*, then certainly the *Brazilian Scarab* must be allowed to exceed in GLORY, all the *Solomons* now living upon the Face of the Earth, put together.—But I will not detain you any longer at this time, my *Euphrosyne*, as at your leisure you may inspect the curious Workmanship in every Part of this most elegant, genteel, and delicate Fly.

DIALOGUE

DIALOGUE VIII.

The CONSIDERATION of remarkable INSECTS continued. Of the Libella, or DRAGON FLY, HORNET, BEE, WASP, SCORPION, GNAT, FLEA, LOUSE, BUG, WALKING LEAF.

Cleonicus.

THOUGH I can't propose to entertain my *Euphrosyne*, at this Time, with such wonderful Scenes of Beauty and gorgeous Attire in Insects, as the last Opportunity afforded; yet there still remain enough of this Tribe of Animals to command and fix the Attention of every philosophical Mind. I shall therefore present you in the first Place with the whole Insect compleat, in which sometime ago you so much admired one single Part only.

Euphros. I cannot well guess at the Insect you mean, *Cleonicus*, as you shewed me the Parts of several in the Microscope.

Cleon. Don't you remember the *Hexagons* in the Eye of a Fly, which you saw so largely magnified in the dark Room?

Euphros. I must remember what I cannot forget, *Cleonicus*,—it was too noble a Phænomenon to slip out of my Mind very soon.

Cleon. Well, there is the Insect itself, my *Euphrosyne*.

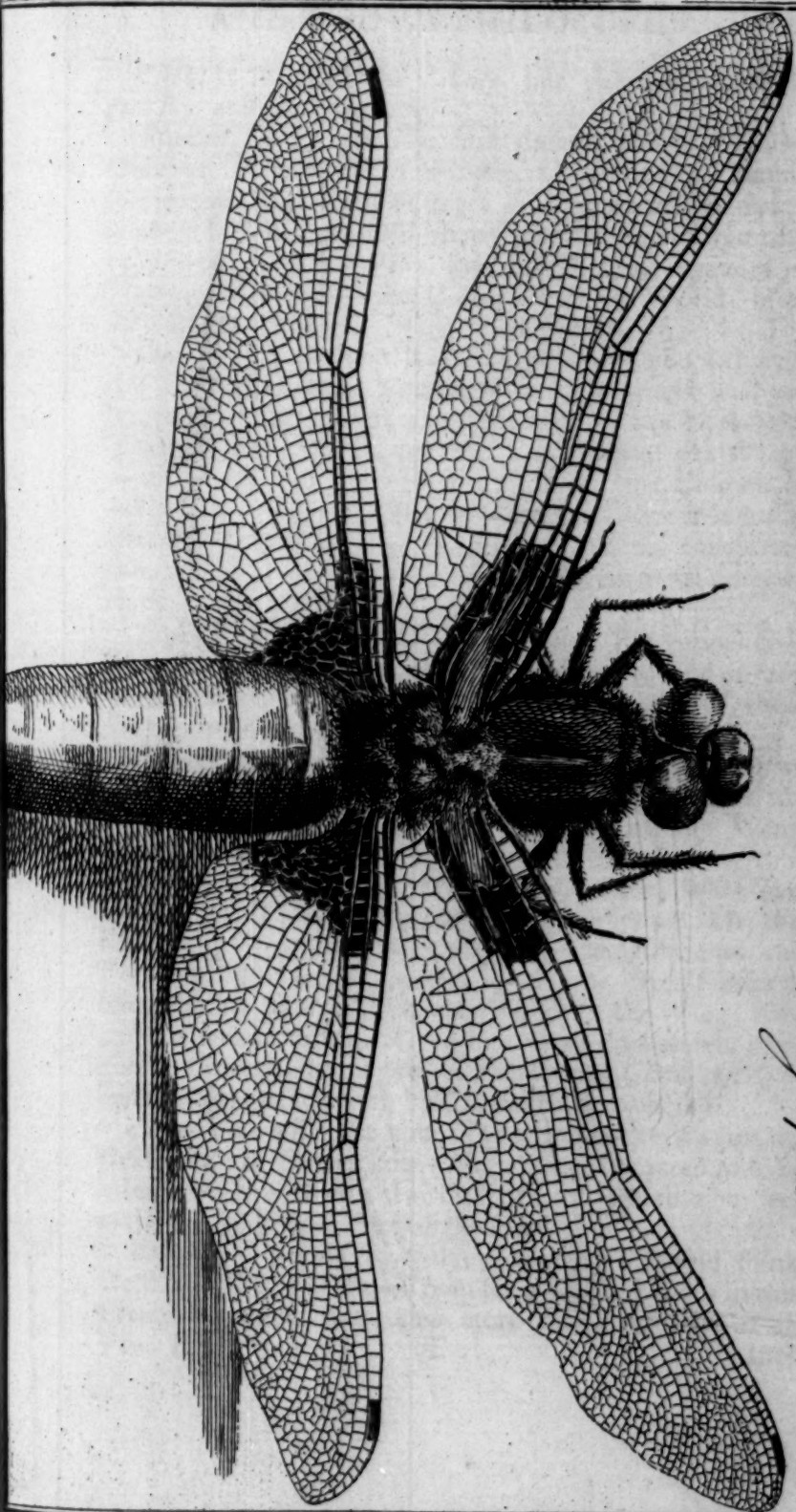
Euphros. O! shocking, *Cleonicus*, what have you got here?—pray don't bring it near me, while it is alive, and looks so fierce.

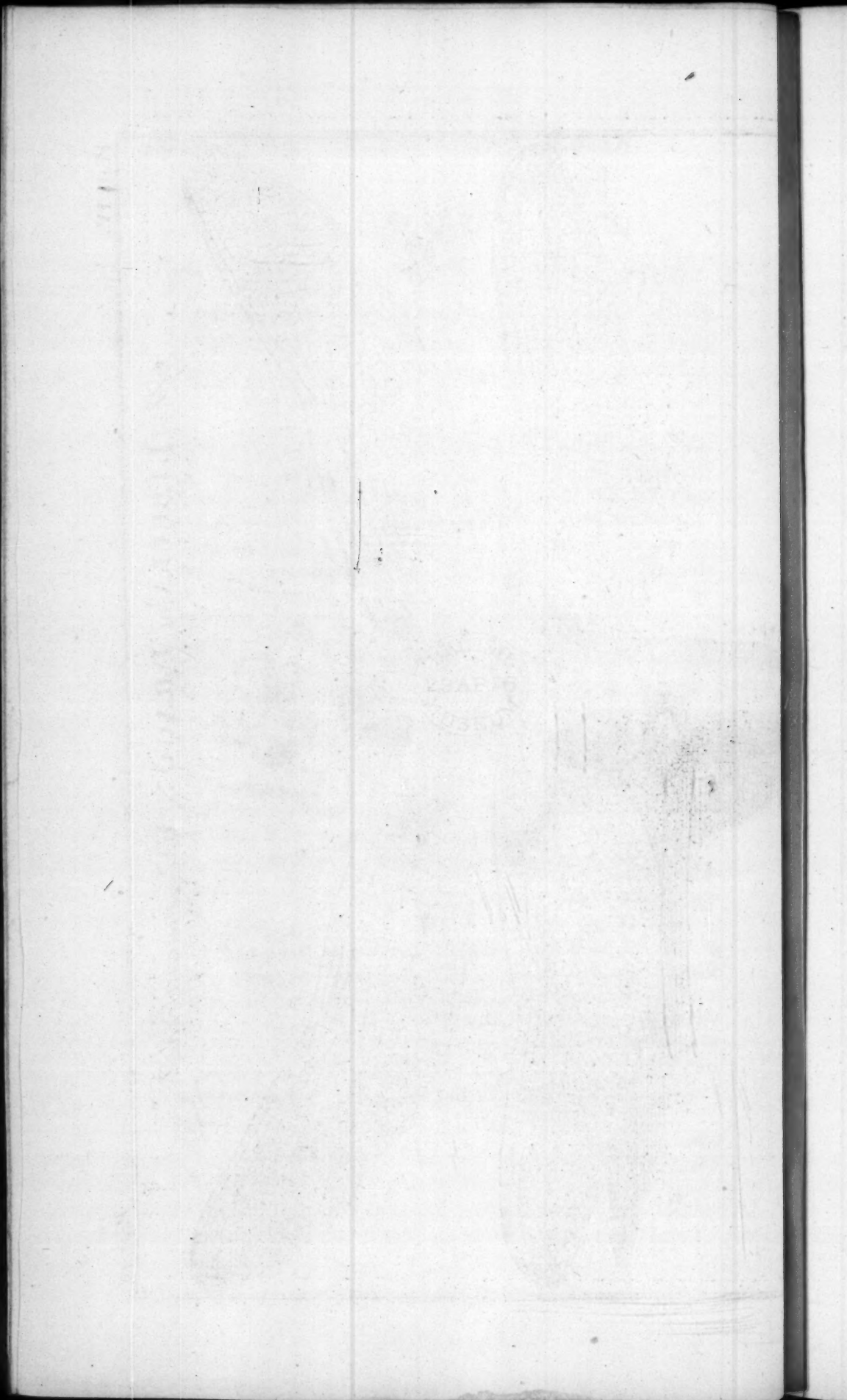
Cleon. I find you have not Philosophy enough yet, to know when any Thing is *alive* or *dead*,—indeed it must be said in your Behalf, that Death never shews its Terrors in any Creature so little as this.—You see, my *Euphrosyne*, what piercing brilliant Eyes can do, even in Insects.

Euphros. Well, though you assure me it is dead, I can scarce venture to touch it—pray what do you call it, *Cleonicus*?

Cleon.

The LIBELLA, or DRAGON-FLY, magnified.





Cleon. It is called the *Libella*, but vulgarly the *Dragon-Fly*, and *Adder's Spear*.

Euphros. A *Dragon-Fly*, sure enough, this!—I fancy, *Cleonicus*, it must be from this Creature that People formed their first Idea of a *Dragon*.—What a horrible Mouth is there! What dreadful glare from two such large and prominent Eyes!—What striking Wings, expanded in Death, are these!—I would not, for all the World, meet such a Creature on the Wing, in the Fields.

Cleon. Well, but now it is dead, it can do you no harm, my *Euphrosyne*—take a nearer View of it—mark well the largeness of the Form, and brilliancy of the Eyes—the Texture, the Length, and fine Expansion of the Wings—and of its wondrous Figure, Fashion, and Colours in every Part—you will then readily confess that it is justly esteemed by Naturalists, the KING of all the *transparent four-winged Tribe* of Insects, of our own Country at least.

Euphros. I make no Doubt but royal Pre-eminence is due to it, as such Eyes and Wings I never saw in any Insect before—I should be glad to view one of those Wings in the *Megala-scope*, *Cleonicus*, if you please.

Cleon. I have adapted one to your View, my *Euphrosyne*—move the Slider as you want, and you will observe the singularly fine Structure and Beauties of the Wing throughout.

Euphros. Fine Structure indeed, *Cleonicus*; what can exceed the Transparency of the Membrane? Or the beautifully irregular Branching and Contexture of the Frame-work which supports it—in one Place I observe that which I took only for a dark Spot in the Wing, now appears wonderfully displayed in a solemn Grandeur of a golden Ground, like some of the stained Glass in *Westminster Abbey*.—How rich! How noble the whole!

Cleon. You will take your Time to explore it's further Beauties, my *Euphrosyne*.—We will next proceed to examine the Eye of this Insect, both of which you see, make the far greater Part of the Head.

Euphros. They do so, truly, *Cleonicus*; I should think there could be very little Room for a Skull or Brain in this Creature;—each Eye seems more than a Quarter of an

Inch long—I can almost discern the *Hexagons* with my naked Eye.

Cleon. As you have already viewed these *hexagonal Figures* through the Microscope, I shall make it my Business now to shew you that they are each of them a true or real *Convex Lens*, and have the very same Effect in making an Image of an Object placed before them—I shall confirm the Truth of this by an Experiment of the Sash Window, the Panes of which will appear in many of the Hexagons at once, and even the *Wafer*, which I have stuck upon one, will be seen distinctly in all.—Apply the Eye to the Glafs.

Euphros. I do; I can see every Thing you mention—the Bars of the Window-frame—the Panes of Glafs—the Wafer itself on one of them—but I see as many Windows, and Panes, and Wafers, as I see Hexagons, distinctly—and if I move the Reflector, I make all Parts of the Window pass successively over the Lenses—there needs no other Proof to convince me that every such Hexagon is really a Lens, as you affirmed.

Cleon. Being assured of that, my *Euphrosyne* will consider the Consequence, viz. that as many Images must be formed of external Objects upon the *Retina* at the Bottom each Eye, as there are Lenses in the Surface;—of these there are about 13537 in each Eye, or in both, 27074—now, our own two Eyes form two Images, one upon the *Retina* of each Eye, and these two Images the Mind conceives but as *one*, because the two Optic Nerves are united in the common Sensory of the Brain, as you were in a former Discourse taught to understand—therefore these 27000 Images being, by Means of the *Optic Nerves*, united in one in the common Sensory of a Fly, it must perceive from them all (as we do from two only) the *Species* or *Idea* of the Object to which they belong, that is, it sees the Object itself.

Euphros. You have before instilled into my Mind such a competency of Knowledge of Vision in the Eyes of Quadrupedes, that I now easily comprehend all you say with regard to *Vision in Insects*.—But, *Cleonice*, will it not follow from this Doctrine of *Multocular Vision*, that the
Sight

Sight in a Fly is vastly more exquisite and perfect than what we have by one or two Eyes only?

Cleon. You have undoubtedly Reason to think so, my *Euphrosyne*; because, though we don't see twice as well, yet we see much better with *two Eyes* than with *one*.

Euphros. Pray what Sort of *Optic Nerve* do you find in a Fly's Eye? Could you shew me any thing of it in the large Eye of this Dragon, *Cleonicus*?

Cleon. I can, my *Euphrosyne*, in one that I have prepared and reserved some Time for this very Purpose—It is the whole *Cornea* dried, with a dark Lining on the Inside, like the *Choroides*; and all over that, you will see a fine Appearance of the *Retina* in Form of very small, White parallel Fibres, like Threads of Silk.—Look at it in the *Opake Microscope*, which gives the best View of it.

Euphros. Nothing can be more conspicuous, and perfectly a White silken Tissue.—This is a much more distinct and delicate *Retina*, in regard to its Texture, than that you shewed me of the Ox, *Cleonicus*—I shall trouble you with but one Query more, and that is, at what Distance do you think Flies can see?

Cleon. I have often attempted to ascertain that Point, but could never succeed to any Degree of Satisfaction—POPE thinks the Distance very small, and gives us a poetical Reason for it in the noted Distich:

*Why has not Man a Microscopic Eye?
For this plain Reason, Man is not a Fly.*

Euphros. Pray what is the next distinguished Tribe of Insects you propose to entertain me with the Contemplation of, *Cleonicus*?

Cleon. Those which Nature has furnished with *Arms* for their Defence, viz. a *venomous STING* in their *Podex*, or hinder Part of the Body. Of this Sort, the Principal are the *Hornet*, the *Wasp*, and the *Bee*.—These in regard to their external Form, are all well known—but the *Sting* is another Demonstration of *divine Contrivance* every Way worthy your Regard, my *Euphrosyne*.

Euphros. I was once attacked by a Wasp, which stung me

me with so much Venom, that I have been afraid of them ever since—I know it is said that *nine Hornets will sting a Horse to Death*—what think you of it, *Cleonicus*?

Cleon. I can't say what nine may do, but I well remember a Person having a Finger stung by a Hornet, had his whole Hand swelled to an immoderate Degree, and continued so in great anguish for three or four Days.—But it is remarkable, my *Euphrosyne*, that none of these formidable *Military* Insects will attack a Person unprovoked—it is only by Way of Revenge, or Retaliation, that they exert their Weapons, and pierce us with their natural *Bayonets*.

Ephros. Pray, *Cleonicus*, what does the Sting of these Animals consist of?

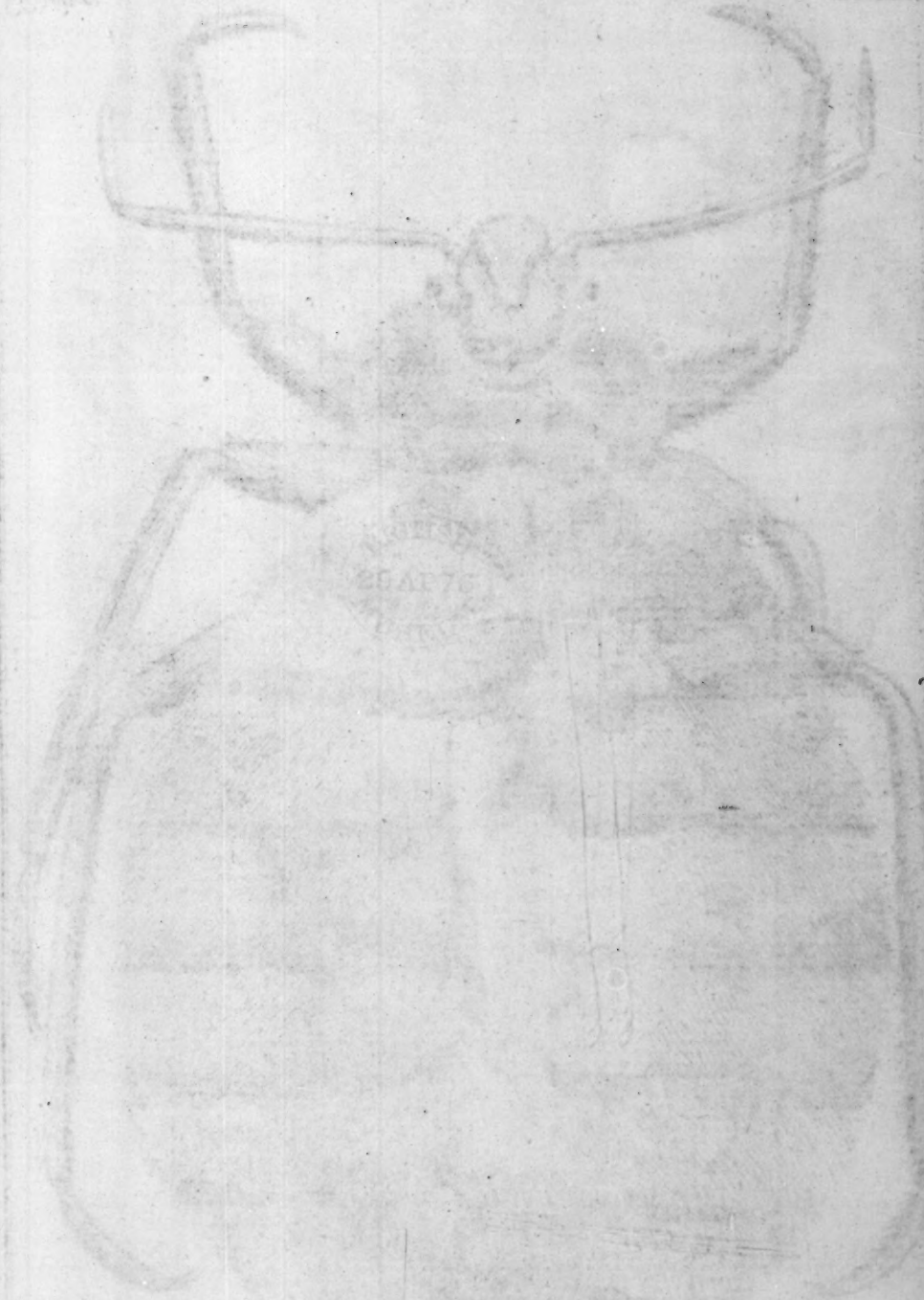
Cleon. Their Mechanism is truly wonderful, my *Euphrosyne*; the external Part is a hollow Tube, tapering to a Point, of a Tortoiseshell Colour—within this are two long sharp bearded Spears, which the Insect can dart out through a Slit near the End or Point of the Sheath—the larger inmost End of this Sheath is connected within the Body, to a Bag of Poison.—Hence in the *Act of Stinging*, the Animal first darts the barbed Spears into our Flesh, then follows the pointed Sheath, and conducts the Poison into the Wound, which causes the Pain and Swelling.—And unless Time be allowed for the Bee to withdraw the Spear gradually into it's Scabbard, they are left in the Flesh, and the Insect soon after dies.

Euphros. Pray, *Cleonicus*, do you reckon the SCORPION an Insect? I find, by Reading, that it has a *Sting*, and a terrible one too.

Cleon. It is a Sort of anomalous Insect, my *Euphrosyne*—It has no Wings; but eight Legs and eight Eyes; two of which look right forward, and three are placed on each Side the Head.—The Body is of an oblong Form and covered with a hardish Skin.—There are *two Claws* at the Head, like those of a Cray Fish, or Lobster, armed with strong Pincers.—And behind, it has a long *jointed Tail*, at the End of which is a piercing *Sting*, which it can dart out at Pleasure—at the End of the Sting is an imperceptible small Hole, through which an exceeding small Drop of the most deadly Poison issues into the Wound

A MICROSCOPIC VIEW OF A BUG

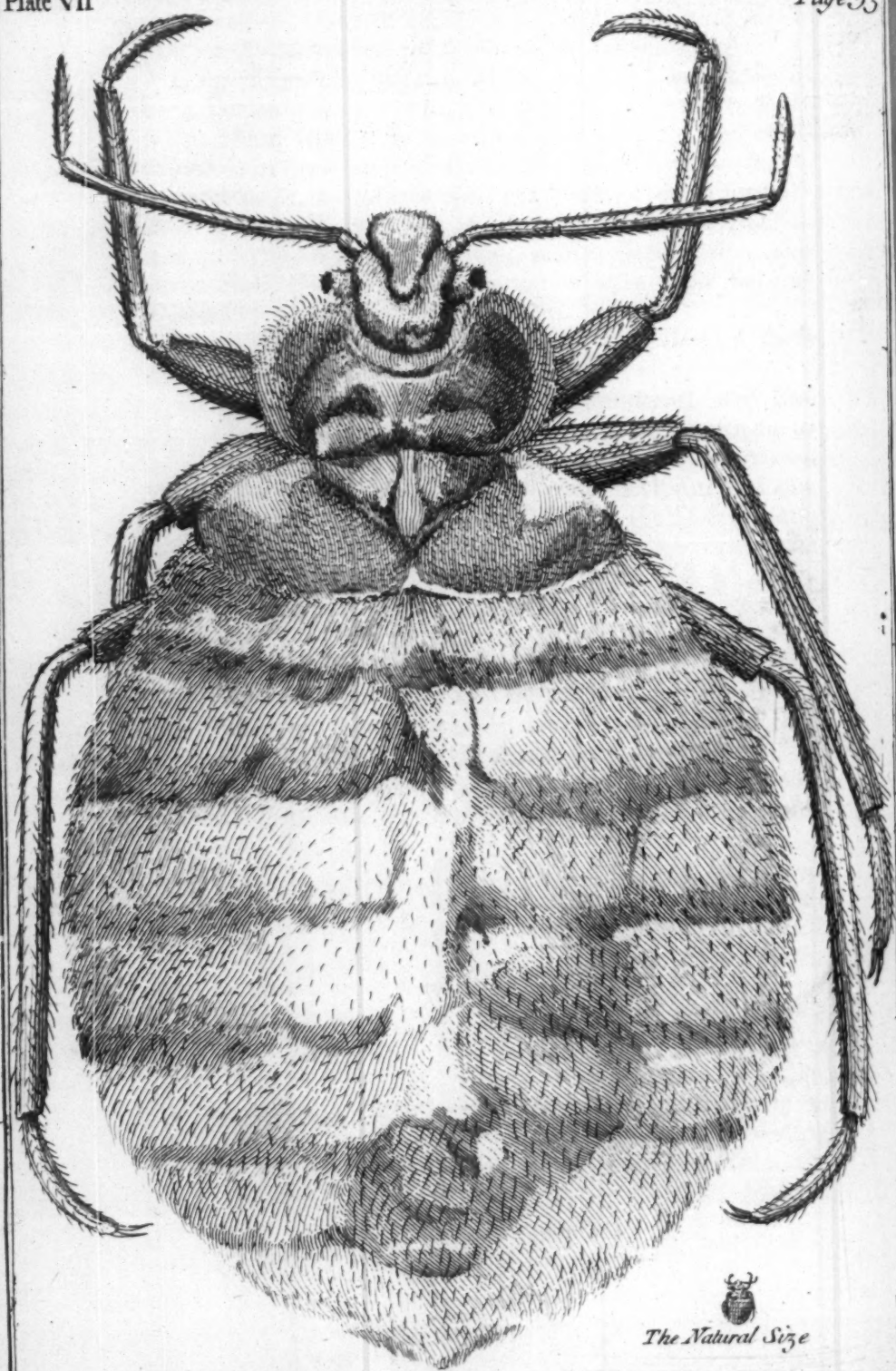
PLATE VII



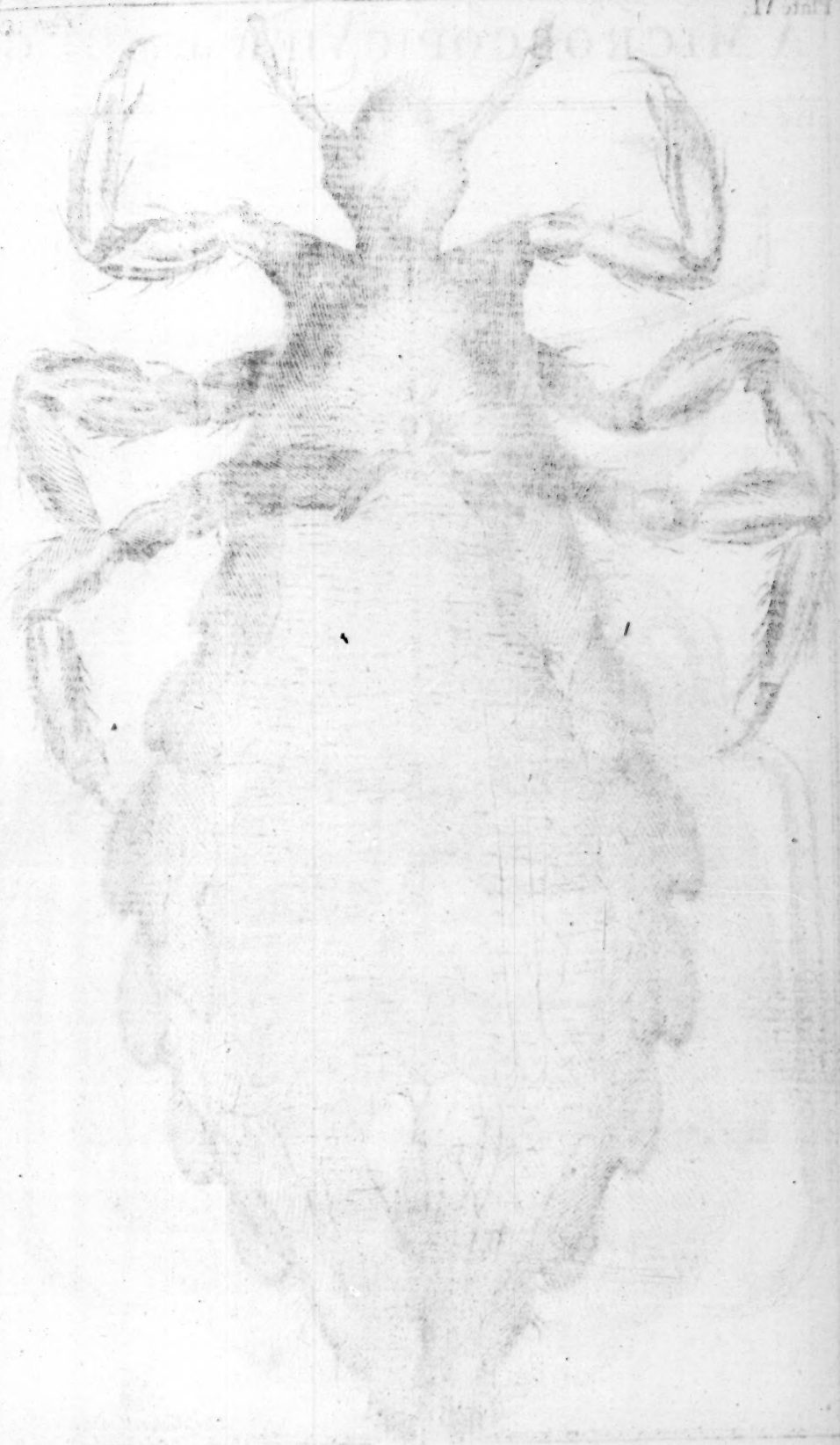
A MICROSCOPIC VIEW of a BUG.

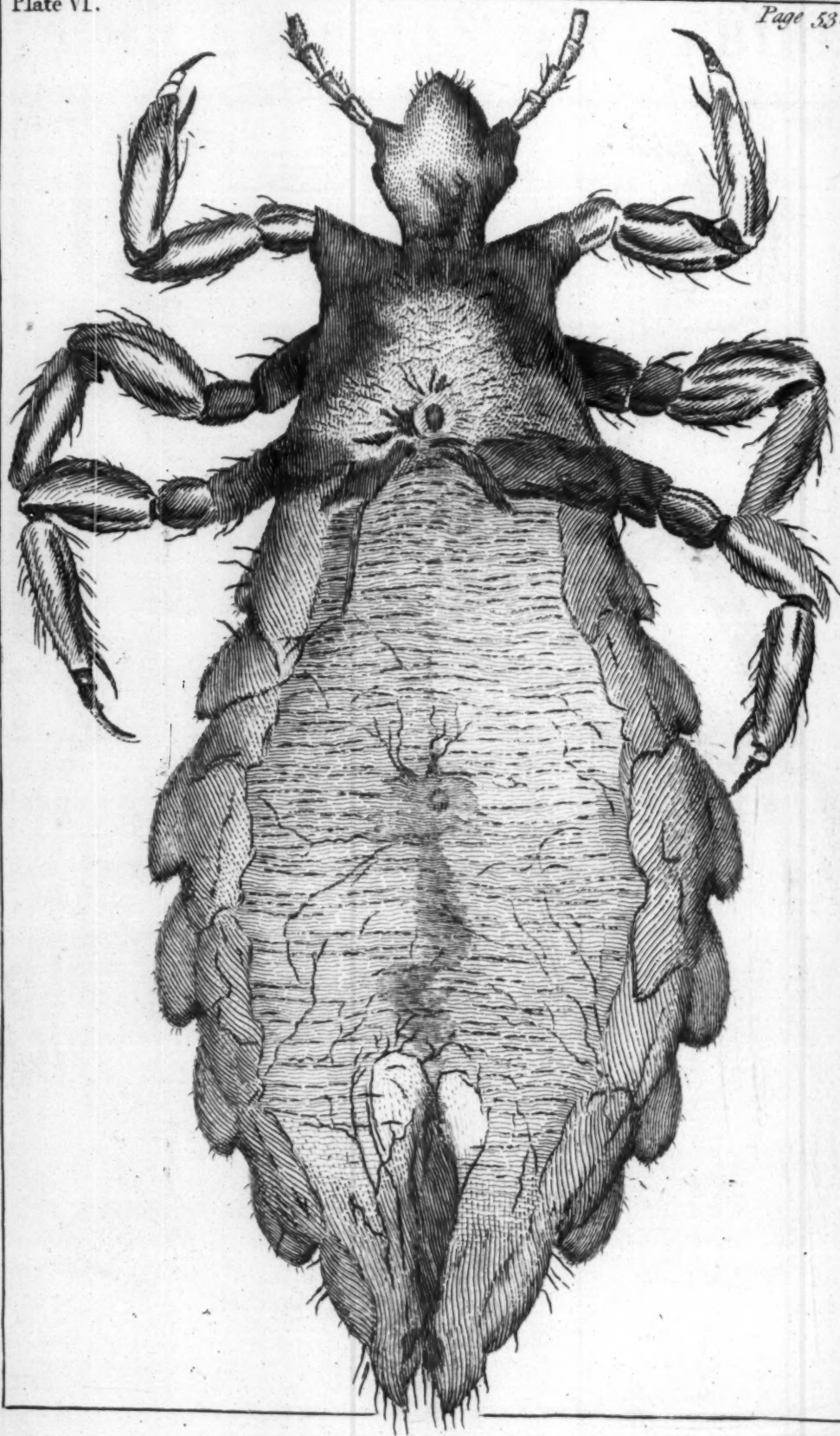
Plate VII

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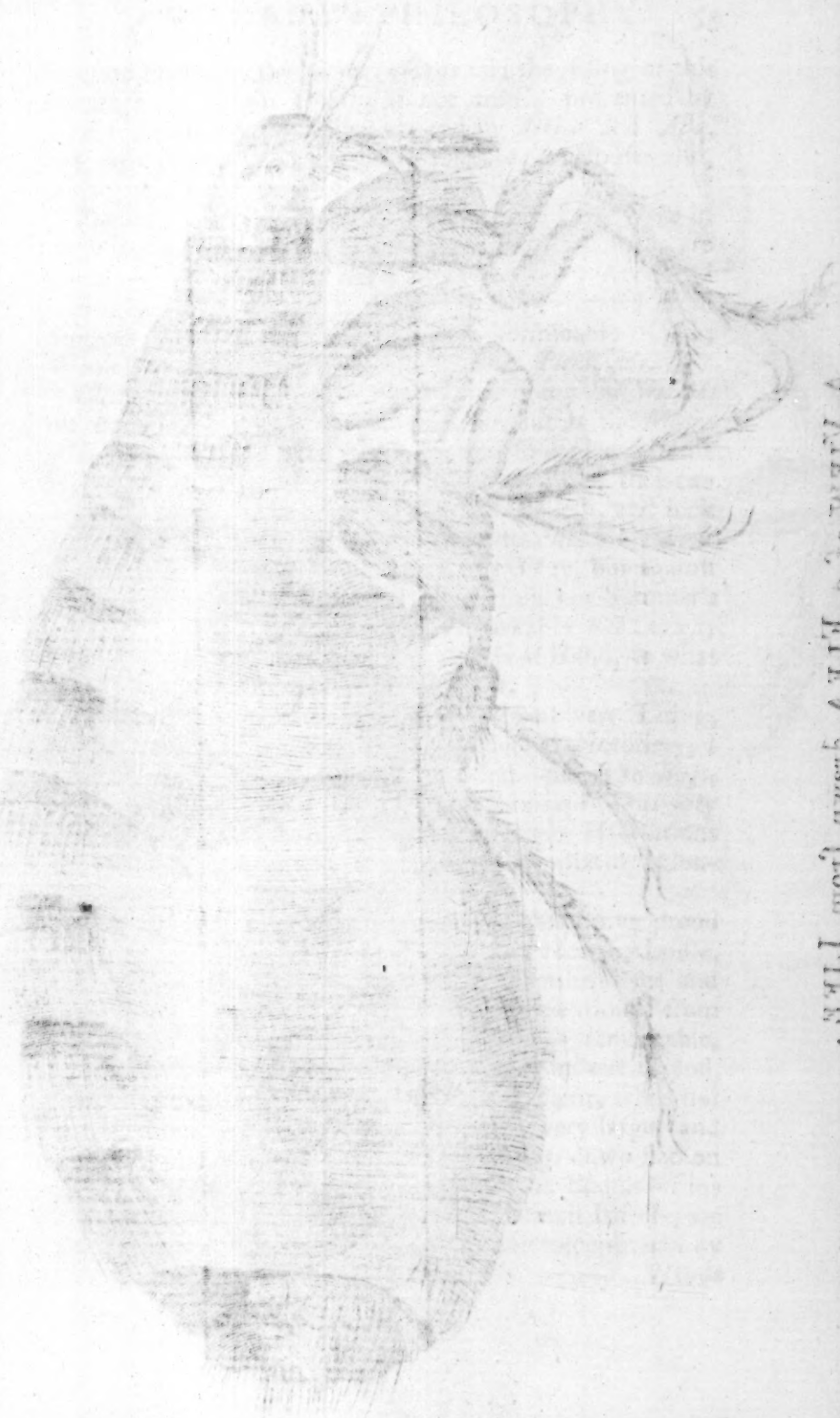


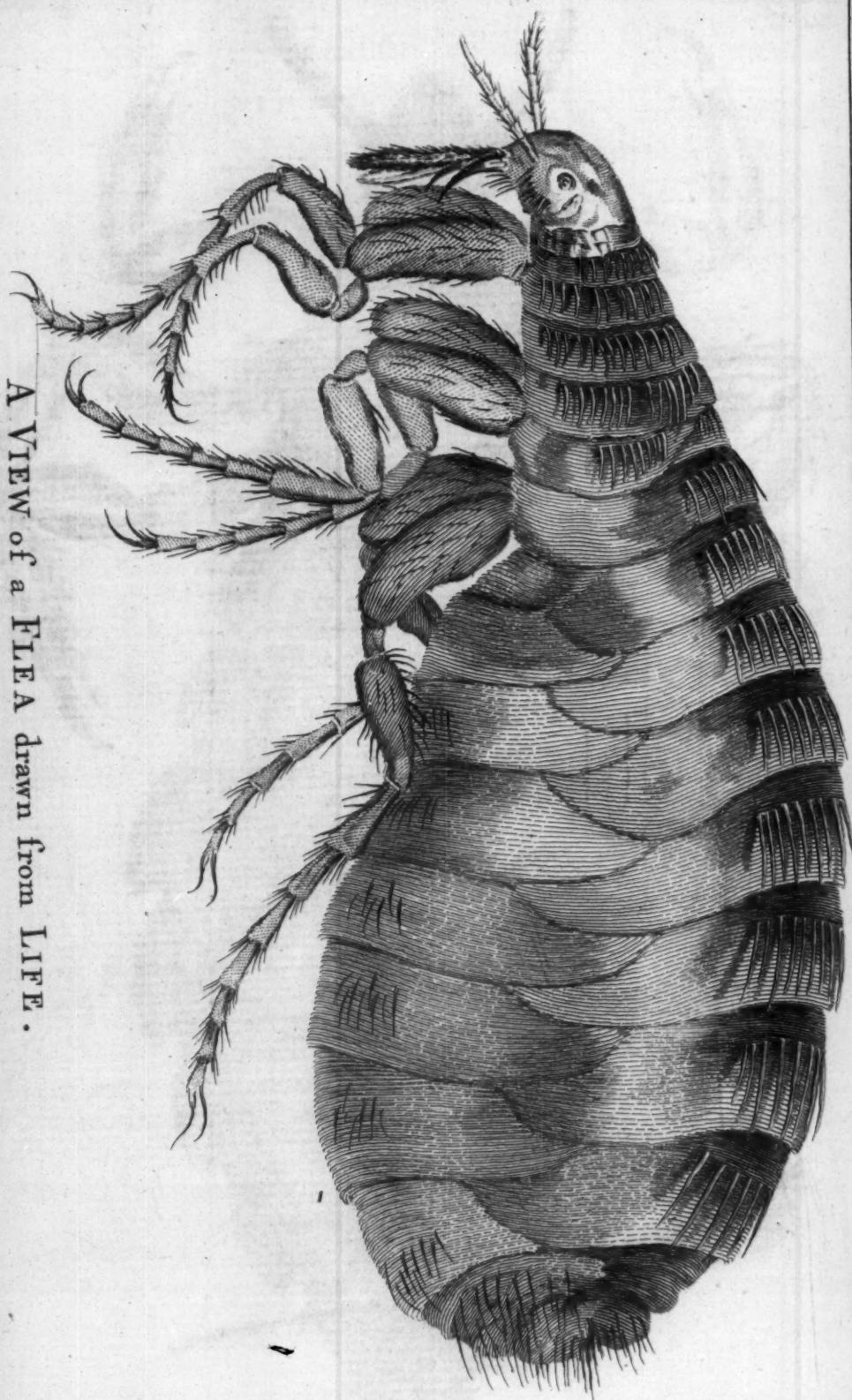
The Natural Size





A VIEW OF A FLY FROM THE





A VIEW of a FLEA drawn from LIFE.

Wounded made by the Sting.—It is said the Sting of this Creature is certain Death, if not timely prevented by proper Applications.—They abound in *Africa* and *Asia*, not only in the Woods; but in *America*, in Houses also, to the great Annoyance of the Inhabitants.

Euphros. Well, I hope 'twill never be my Lot to live in those Parts of the World where such dreadful Animals are found.—How blissful is our Climate on every Account! —But yet, *Cleonicus*, I find we are not exempted from *Stinging Animals*, though of a less formidable Kind; Witness the Tribes of *Flies*, *Gnats*, *Bugs*, *Fleas*, &c.

Cleon. But the Stings of these Insects, my *Euphrosyne*, we consider not as *Arms* or *Weapons*, but as the *Means of Life* to them.—These Stings are therefore placed in the Head, and by a wonderful Mechanism of Parts, they can instantly force the fine Pointrel into our Flesh, and suck our Blood for their Subsistence.—As to *Flies* and *Gnats*, they are seldom very troublesome this Way, but against the approach of a Shower or Tempest in a hot Summer's Day—But why they should be so remarkably *blood thirsty* against Rain, or how they can tell it is at Hand, is what my Philosophy is unable to Account for.

Euphros. I have often wondered at that very Thing, which though it is a Fact of such universal Notoriety, I must never expect to understand, I find—but as to *Bugs*, *Fleas*, and *Lice*, what shall I say, *Cleonicus*? Our very Bodies seem to be destined equally for their Habitations and their Food—is not this a most humiliating Consideration!

Cleon. And yet, my *Euphrosyne*, notwithstanding proud Man is so disgraced and degraded by every Flea and Louse, you will find him still vaunting of his Consequence and Importance, as in the *Fable* you lately mentioned from *Gay*.—But to return to our Subject—it is remarkable, that this *Proboscis* by which Insects draw out our Blood, is situated within the Mouth, and out of Sight, when not in Use; but in the Bug (or *Cimex*) it is very large, and placed on the outside of the Head, turning down flat on the Belly, and reaches half Way down the Body.—This Part, and indeed, all other Parts of these small Insects, are much more perfectly described by the Microscope than by

Words—and in this View of them, you will admire the *divine Workmanship* displayed in each, which will amply atone for their biting you now and then—also their Eggs or Nitts, from which they are bred, will afford you a curious Spectacle at any Time.

Euphros. I find the Microscope the most eloquent Orator for describing and explaining the mysterious and wonderful Works of Nature.—Now for some other Curiosity of the Insect Kind, *Cleonicus*, if you please.

Cleon. The next which I shall mention to you, my *Euphrosyne*, is a singular Curiosity, confessed by all.—It is called *The WALKING LEAF*, and the Reason of its Name is evident from its *Form* and *Motion*, could you see it alive; but I have only a dead one to shew you.—It is brought from the *West Indies*—has a flat Body of a reddish Colour, like that of certain dry Leaves—but when young it is Green, and is produced from a Green Egg.—The Wings are at first like a *Green Leaf*, having Fibres running along it from the inward Edges to the outward, and they branch into Subdivisions as they come near the Edge, as you observe in many Sorts of Leaves.—On the fore Part of the Body you see four other small Wings, which though they differ in Shape, yet they exactly resemble some Sort of Leaves.—And when the larger Wings are shut close, the whole has such an Appearance of Leaves, that being in motion, it must look like a *Walking Leaf*.

Euphros. This is a curious Oddity indeed *Cleonicus*, both as to its *Vegetable Aspect*, and the Form of its Body. It seems almost, to have two Heads——how wondrously the Wings are disposed upon the Body.———I see there is no End to the Infinity, Variety, and Combinations, of Nature—she makes an Animal ape a Plant, and a Plant an Animal.—How incomprehensible are even the very *Sports of Nature*.

Cleon. You observe very justly, my *Euphrosyne*, that there is such an endless Variety in her Works of any one Sort whatever, that it is impossible to acquire a Knowledge of more than some of the most singular and Capital Ones; and of these there yet remain several for the Subject of our next Conference.

DIALOGUE

DIALOGUE IX.

Of the Natural INSTINCT, SAGACITY, PROVIDENCE, ART, Divine GEOMETRY, Phosphoreal, and other QUALITIES of INSECTS.

Cleonius.

WE have already surveyed most of the external Beauties and Forms of Insects, my *Euphrosyne*; but their *internal Faculties and Powers* are so many, and so amazing, that I think nothing can be more worthy our Contemplation at present.

Euphros. Nor will any one be more delighted with the Speculation of such great Subjects than *Euphrosyne*.—Therefore, dear *Cleonius*, proceed.

Cleon. MANKIND compliment themselves with what they call *Reason*, and bestow on Brutes the faculty of *Instinct* only; that is, they take a *fallible Guide* for their own Actions and Conduct in Life, and ascribe to Brutes an *infallible* one.—But in this they are certainly right, for a *Free Agent* can never be governed like Brutes, by the Fatality of *Instinct*.—*Virtue* and *Vice* are founded in *Reason* and *Free Agency*, but nothing of that kind can be predicated of the Brute Creation.

Euphros. One would think that according to your Doctrine, *Cleonius*, Brute Animals were mere *Animal Machines*.

Cleon. Why suppose you were to think so, my *Euphrosyne*, you would not be far from Orthodox.—A Brute is actuated by a divine and infallible Principle, and is therefore a mere Machine, endued with *Life*, *Sense*, and *Mind*; and on this Account it becomes a most excellent and inimitable Artist.—We may as well pretend to imitate Omnipotence itself, as the Insect it produces!

Euphros. Well I never viewed Insects in so awful a Light before.—I long, *Cleonius*, to hear you enumerate some of the principal Instances of their inspired Science and Sagacity.

Cleon. That of the *Bee Kind* is of the greatest Note, as being nothing less than a *Divine GEOMETRY*, by which they construct the *Cells*, and fabricate the *Combs*, containing their Honey.—This, my *Euphrosyne* is a Subject of great Amazement, and has been so to *Mathematicians* of the first Rate, in every Age.—For since there are only three differently figured Bodies, that can fill a Space compleatly (or without any Vacancy or Loss) viz. one of *three Sides*, one of *four Sides*, and one of *six Sides*; it is wonderful to observe, that the Bee has chosen that one which is a *Maximum*, or contains *more Honey* under the same Surface than either of the other two.

Euphros. Great Sagacity surely! and this most eligible Figure, or Form of the Cells, I observe is that with *six Sides*, *Cleonicus*; I have often admired this Figure of the Cells, but never knew the Reason of it before.—But supposing the Cells had been *round*, would they not have done as well or better? I should have thought they would have been more easily made.

Cleon. A single Cell of a round or cylindric Form will contain more Honey, it is true, under the same Surface than a *hexagonal* Cell; but then consider my *Euphrosyne*, that when several of these Cylindric Cells are to be placed together, in order to make a Comb, a great deal of vacant Space between them, will be lost, but none at all is lost by the *Hexagon-Form* of Cells; therefore, to contain the same Quantity of Honey, the Comb of Cylindric Cells will be much larger than in the present Case.—So that take the little CITY of the BEES in what Light you please, you will find these curious *Architects* perfectly in the Right.

Euphros. I see the Reason of all you have said very clearly, *Cleonicus*; and your mentioning their *Waxen City*, reminds me of *Virgil's* Description of Bees, as a *Body Politic*, and their Government, as it were, by *King, Lords, and Commons*, like our own.—Nay, he goes farther, and asserts that they have not only *Civil* but *Military Government*, understand the Arts of War to Admiration, draw up their Armies in Battle Array, fight with the Fierceness of Heroes in the Air, and fill the Ground below with Carcasses of the slain.

Cleon. All this is true, my *Euphrosyne*, if you Change
the

the King for a Queen Bee.—Virgil was a more excellent Poet than Philosopher.—The Moderns, by Means of *Glass Hives*, have discovered every Thing to be true respecting the Queen Bee which the Ancients ascribed to the King.—But that their *First Magistrate* is of the *Feminine Gender*, they know, by seeing her through the Glass, deposit her Eggs in the Cells, appropriated to that Use.

Euphros. But what are the different Orders or Kinds of Bees which compose this *Liliputian Community*, *Cleonicus*.

Cleon. There are three Orders among them, my *Euphrosyne*; The first is *one single Bee*, formed by Nature for *Sovereignty*, with a larger Body, and a more Majestic Air and Mein; so that she is eminently seen, and distinguished from the Rest.—Secondly, the next Order of Bees, are of a less Size, always attendant on their Sovereign, are all of the Male Kind, and are quite unconcerned in the Labours of the Hive, and therefore called *Drones*.—The third or last Order, is that of the common *Working Bees*, supposed to be of no Sex; but are always intent upon Building Combs, gathering the Honey from Flowers, and storing it up in proper Cells against Winter.—These always compose the *Swarm*, led forth by the *Queen* to seek new Quarters, and settle a Colony in some convenient Part of the Neighbourhood.

Euphros. As there are Bees of different Ranks and Quality, to I suppose they make their Cells accordingly, for the peculiar Accommodation of each.

Cleon. They do so; for some are very large for the Queen and the Nobility; others of a less Size for their *Nymphæ*, or Maggots; other Cells are designed for Magazines of War; but the bulk of the Combs consists of Cells in which they deposit their Honey.

Euphros. I have seen those busy Gentry ostentimes collecting the Ambrosial Sweets of Flowers; but how, *Cleonicus*, do they convey it home, and make Honey of it?

Cleon. They exhaust it, by their Trunk, from the Flower into a proper Vessel in their Body, called the *Honey-Bag*, which having filled, they return to the *Hive*, disgorge it into the Cells in Form of Honey; and as this

Vesicle

Vesicle is as big as a small Pea, six or seven thousand Bees will soon, by their incessant Labour, replenish the Combs with the delicious Food.

Euphras. I presume too, *Cleonicus*, that the *Mealy Matter* which the Bee collects from Flowers, and sticks on her Legs, and with which her Body is sometimes almost covered, is that Substance with which they make the Comb or Houses.

Cleon. You are perfectly right, my *Euphrosyne*; these Mealy Particles contain a very fine limped Oil or Spirit, and being bruised, they easily work them up into a Sort of Paste which you see in Lumps on their Legs.—This they carry Home to the Hive, where they meet with great Numbers waiting constantly on the outside to receive it from them, as also the Dust from their Bodies.—This they carry in to the *Working Bees*, and the others return for more.—The numerous *Wax-Masons* in the Dome, with their Mouths, Pincers, Teeth and Feet, soon make it into an adhesive Terras, and therewith fabricate their Cells.—

Euphras. Pray, *Cleonicus*, are the Cells of the *Hornet*, *Wasp*, and *Humble-Bee* made in the same Manner?

Cleon. Pretty much so, my *Euphrosyne*, but not with the same Materials.—For the *Wasp* makes the Comb with fine *Fibres of Wood*, which, with a Sort of Glue, they work into a Paste, and then reduce it to a Leafy Form; of these Leaves laid upon one another, they construct their several Stories of Paper Cells, various Pillars between each Story for Support, and a Domicile or Nest, containing the whole.—The *Wasps* make no Provision for the Winter, but either kill or drive out their Young to Shift for themselves.—They have many Females, many more Males, but the *Working-Wasps* are by far the greater Number.—They are very great Enemies to the Bees, whom they not only rob of the Honey, but devour their Bodies likewise.—But that you may have a more correct Idea of the Ingenuity of *Wasps*, I here present you with a Nest compleat, cut open on one Side for you to see their curious Workmanship within.

Euphras. A curious Present this; I think my dear *Cleonicus* is very solicitous about my Philosophical Erudition.—

Cleon.

Cleon. Give yourself no Concern about that, my *Euphrosyne*.—I am determin'd no other *Euphrosyne* shall take Precedence of mine, in that Respect.—I purpose also to Purchase of Mr. *Wildman* a *Glass Hive* of the best Sort, in which you will behold with Admiration, all the Operations and Oeconomy of Bees, the so much celebrated *Architects* of the Insect-kind.

Euphros. O, *Cleonicus*, you will make me too wise—but pray, is not this the famous *Wildman* who is so much celebrated for his strange Feats and Performances with Bees?

Cleon. The same Individual *Wildman*, my *Euphrosyne*,—He is as much famed for his singular Skill and surprising Dexterity with regard to Bees, as *Breslaw* is for his *Legerdemain*.—He is possessed of a Secret by which he can at any Time cause a Hive of Bees to swarm upon his Head, Shoulders, and Body, in a most astonishing Manner.—I saw him drink a Glass of Wine with the Bees all over his Head and Face more than an Inch deep—several fell into the Glass and his Mouth, but they knew him too well, to sting him.—And he has taught his *Lilliputians* so much *Politeness*, that they never attempt the least rudeness to any who resort to see the Spectacle.—Nay he goes so far as to act the Part of a GENERAL by marshalling his small but numerous Army in *Battle Array*, upon a large Table—there he divides them into *Regiments*, *Squadrons*, *Battalions*, and *Companies*, according to *Military Discipline*, waiting the Word of Command.—The General then says, *March*;—and instantly they begin to March in the regular and uniform Manner, *Rank* and *File*, exactly like the Soldiers in their Exercises on the Platform in St. James's Park.—Such a *Manœuvre* I should have thought beyond the Art of Man to effect, if I had not been an Eye-Witness of it.

Euphros. What wondrous Arts has Providence imparted both to the *Man* and his *Bees*.—Now, *Cleonicus*, let us a little Speculate on the exceeding Wisdom, Providence, and Industry of ANTS so much celebrated in sacred and profane History.

Cleon. Perhaps my *Euphrosyne* may have heard much more upon that Subject than ever can be verified by Experiments,

periments, made in the most critical and circumstantial Manner possible.—Nay, what is more, the direct contrary is notorious and certain from the same Experiments. Three of our most celebrated *Insect Philosophers*, *Swammerdam*, *Reaumur*, and *Carrè*, all agree from numberless Experiments they severally tried for many Years together, that Ants are so far from being industrious and provident in collecting Stores, and making Magazines of Provisions for the Winter, that they *never eat at all* during that cold Season, but were always found in Heaps one upon another, in a torpid State, which could hardly be called Life.—True, they live together during the Summer, and bring to their Hillocks almost every Thing they meet with in their Public Roads, for such they have on every Side of the Hill.—They are not fine mouthed, for they eat but of every Thing when they do eat—and if a Toad, Frog, Insect, or any Animal be thrown amongst the larger Sort, called the *Horse-Emmets*, or *Pismires*, they soon fall to work upon it, and will pick every Particle of Flesh off their Bones; and they thus exceed the most dextrous *Anatomist* in the Art of making *Skeletons*.

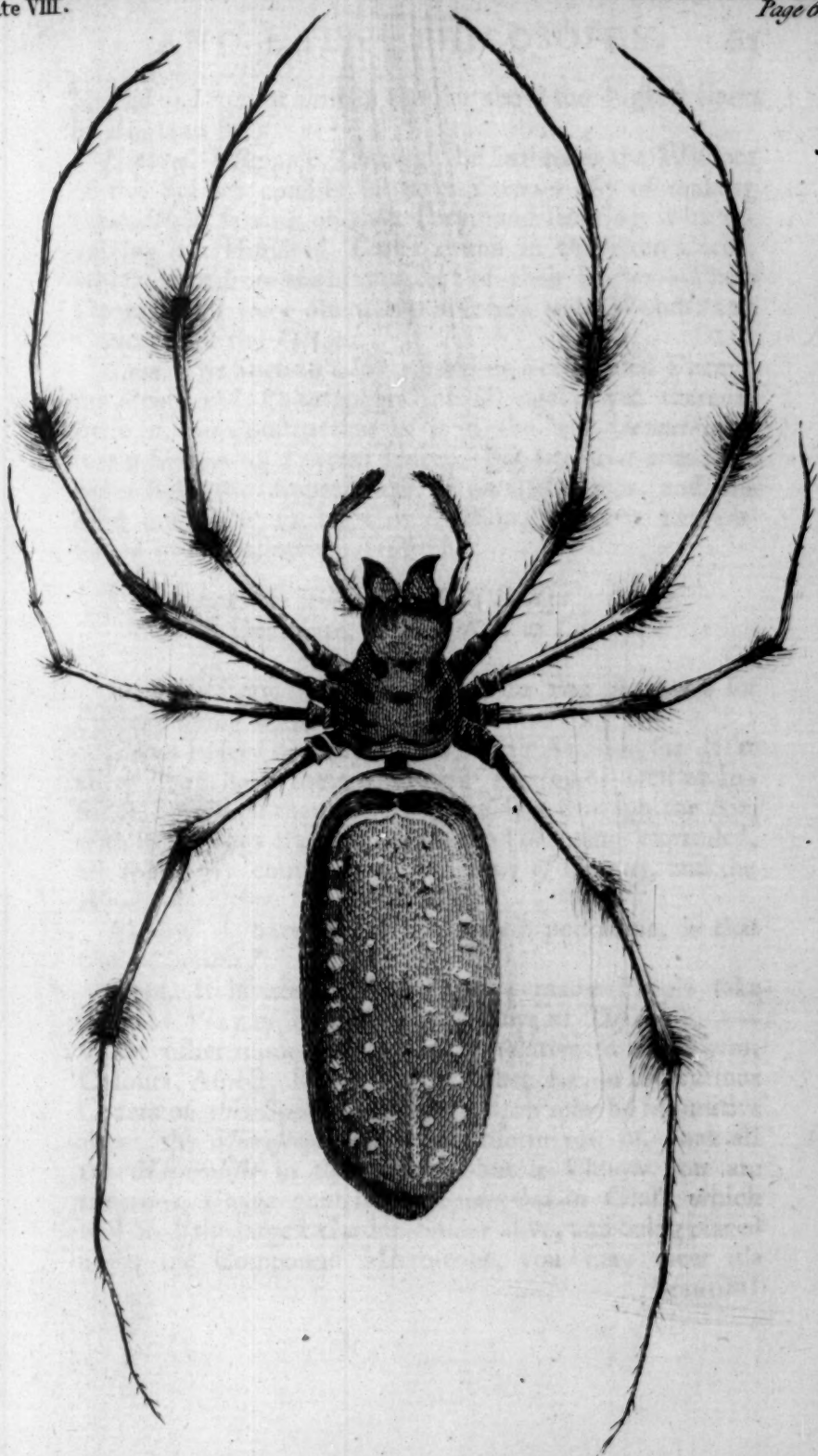
Euphros. Well, I thought the Ant had been almost as wise as *Argur* himself.—But I find my Mistake.—Pray, *Cleonicus*, is there any such vulgar Error in regard to the SPIDER, which *Agur* also says is one of the four little Creatures so exceeding wise? (Proverbs 30.)

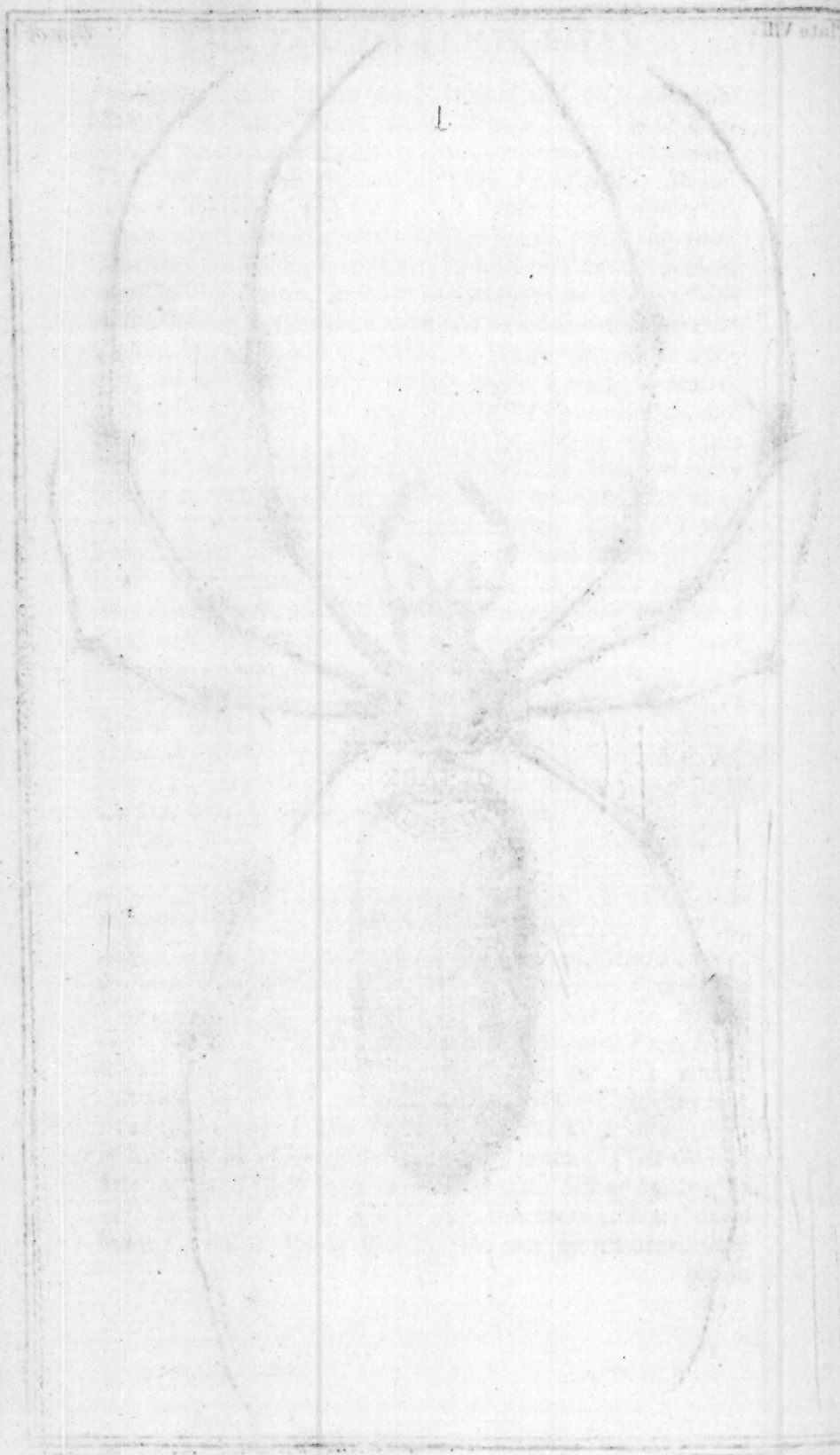
Cleon. If there be any Mistake here, I suppose it is on the other Side; for I dare to say, my *Euphrosyne*, the whole of the Spider's exceeding Wisdom or instinctive Faculties was not known to that antient *Israelitish Connoisseur*—I question if, before the Use of Microscopes, any thing was known even of the most curious Part of it's Form—did *Argur* know if the Spider had four, six or eight Eyes? Did he know the Manner in, and Parts from which he spins those fine Threads or Silk which compose his Web? and the *Gluten* with which they are lined throughout? Did he know that the Web of a Spider is like that of a Caterpillar, but finer, much? That *Gloves*, *Stockings* and *Cloth* have been made with *Silk of Spiders*, as well as of that of the *Silk-Worm*, but more rich and delicate? Did he know that Spiders can *fly* wherever they please

A large AMERICAN WOOD SPIDER .

Plate VIII.

Page 60.





pleased and mount aloft in the Air above the highest Spire in England?

Euphros. I suppose, *Cleonicus*, he intimates the Wisdom of the Spiders consists in their *Textrine Art* of making their *Webs*, seizing on their Prey, and securing it by revolving it a Hundred Times round in the filken Cords, which issues from the hinder Part of their Bodies—These Operations I have oftentimes observed with Wonder and Concern for the *Victims*.

Cleon. The SPIDER'S WEB has been a celebrated Theme, for Poets and Philosophers of all ages; yet there is little in the Construction of it in the least *Geometrical*; it is a System of *Polygons* indeed, but irregular ones; the Sides have the Appearance of parallel Lines, and indeed are really so by Construction, as POPE has observed in the following Distich.

*Who made the Spider Parallel's Design
Sure as Demoivre, without Rule or Line?*

Euphros. Pray, *Cleonicus*, how do you Account for Spider's flying without Wings?

Cleon. Indeed my *Euphrosyne*, I can't Account for it at all.—They have some unknown Energy as well as Instinct, by which they convey themselves through the Air, with their Legs clutched up, instead of being expanded, all seemingly contrary to the *Laws of Gravity*, and the *Means of Flying*.

Euphros. I have heard Spiders are poisonous, is that true, *Cleonicus*?

Cleon. It is not, my *Euphrosyne*; many People take them by Way of Physic, for the Cure of *Disorders*.—What other numerous Particulars relative to the Form, Colours, Aspect, Eyes, Legs, Webs, &c. in the various Orders of this Species of Insects, you may be inquisitive about, the *Microscope* will better inform you of, than all the *Naturalists* in the World—but as I know you are timorous, I have contrived a *Spider-box* in Glass, which will hold the largest Garden-Spider alive, and being placed under the Compound Microscope, you may view it's beautiful

beautiful Colours, Actions, Motions, &c. &c. in the Solar Microscope, these Phænomena will be very entertaining, the Animal itself appearing three or four Feet long.

Euphros. You are vastly obliging, *Cleonicus*.—Pray what other Insects are there of Note?

Cleon. There are some of those called *Noctiluca*, which shine or glow by Night; of this Sort, the most remarkable with us is the Glow-Worm (*Cicindela*) which you must have undoubtedly seen in Hedges in a dark Night, like a little Coal of Fire.

Euphros. I do remember to have seen them, *Cleonicus*, by their shining Light; but I know not what the Form of this Worm is.

Cleon. It is not a Worm, my *Euphrosyne*, but a winged Insect of the Fly Kind, a little longer than the Flesh Fly, and its Lamp is in the hinder Part of its Body, and the whole of which nearly, is illuminated or made dark at the Will of the Creature.—When every thing is still and quiet about it, the Lamp is lighted instantly, by the Light of which, it can see its Way about, and find its Provision—but on the least Noise or Disturbance, the Light as instantly becomes extinct, and you see no more of it, or where the Creature is, till all is quiet again, and the Phosphoreal Fire re-kindled.—This singular Insect has been the Admiration of all Ages.—A Theme for the Poet as well as the Virtuoso, you remember in the Fairy Song.

*But if the Moon doth hide her Head,
The Glow-Worm lights us Home to Bed.*

Euphros. Such wonderful Phænomena must needs inspire all Mankind, that have any Reflection or Feeling—I suppose, *Cleonicus*, there are different Sorts of these Glow-Worms in different Parts of the World, if one knew the Truth, as Nature seems always to delight in Plurality.

Cleon. There is mention made of many in the Writings of Naturalists—But one I have met with not yet described by any, which I have reserved on Purpose to gratify

tify my *Euphrosyne*—it is called the *Pyrolampas*, or *Lanthorn-Fly*; there it is.—

Euphros. A great Curiosity, this; it has transparent Wings like a common Fly, but a long Snout or Horn like a Scarab:—Pray, *Cleonicus*, what Part makes the Lamp in this Insect?

Cleon. The Horn, my *Euphrosyne*, which you observe is very transparent, and when the Insect is alive it is filled with a liquid Phosphorus, or luminous Matter, which gives a Light like a Lanthorn by Night—and when we consider the Size of it (an Inch long, and as big as a Wheat-Straw) you will not wonder at what the Sailors Report, that when great Numbers of them settle upon the Masts and Rigging of their Ships, they illuminate the Decks to that Degree, that every thing may be seen almost as plain as at Noon Day.

Euphros. Very extraordinary indeed! Who can be tired in contemplating the Works of Omnipotence! But pray, *Cleonicus*, is not the Light in these Insects analagous to what we sometimes see in *Rotten Wood*, *putrid Flesh* and *Fish*, *Sea-Water*, &c.?

Cleon. No doubt but it is, my *Euphrosyne*, a *luminous Quality* we find is imparted to many different Substances, both *solid* and *fluid*;—but the most surprizing of all is the common *solid Phosphorus* of the Chemist, of which I have here a Piece to shew you.—You observe I keep it in a Vial of Water, to prevent it from flying away in a constant Fume—I put into it a Goose Quill, and you see it Smoke—I put the Shutters close, and you observe it glow and Smoke like a Coal of Fire—I draw it upon Black Paper, and it gives fiery Traces of Light and Smoke—I write my *Euphrosyne's* Name in Letters of flaming Fire.—Now draw the Tops of your Fingers all along your glowing Name.

Euphros. I do, *Cleonicus*, what then?

Cleon. Then only look at them.—

Euphros. O Lud, O Lud, *Cleonicus*, my Fingers are all on Fire! what shall I do?

Cleon. You need not invoke *St. Lud* so much—'tis but a lambent Flame, and will do you no harm—by this Experiment you see there may be *Light*, yea, a *Flame* in Bodies

Bodies that is perfectly innocent.—But now behold, if I rub the *Phosphorous* hard on the Paper, it sets it into a *Burning Flame* immediately—And what is still more strange, is, that Water itself with Difficulty extinguishes it.—A Piece of this *Phosphorus*, stuck on a large Pin, and held to the Flame of a Candle, takes Fire, and burns with the greatest Violence imaginable, observe the Experiment.

Euphros. I do observe it with wonder; I never saw so fierce a Flame—an inextinguishable Fire indeed!—well, I never knew so much of *Phosphoreal Light* before—I can but love and thank my dear *Cleonicus* for it.

D I A L O G U E X.

The SUBJECT of remarkable INSECTS continued.—

Of the Unicorn BEETLE; the Emerald BEETLE; COCHINEAL; KERMES: Of the METAMORPHOSES of INSECTS; Their Nymphæ, or Erucæ; their Aurelia, or Chrysales. These TRANSMUTATIONS exemplified in the White Froth Insect, and Ephemorous Fly.

Cleonicus.

I Fear I shall tire you on this tedious Subject of *Insects* my *Euphrosyne*—but for the future, a new Scene will open to our View.

Euphros. In so fine, so extensive, and so very fertile a *Field of Philosophy*, it is no wonder if we are so long passing through it; but as it is a Part of the High Road to divine Knowledge, you will never find me fatigued, therefore, pray *Cleonicus* proceed.

Cleon. I have just now purchased a curious *Unicorn Beetle*, which may be truly esteemed the only genuine *Rhinoceros Beetle*, as it has but one uniform Horn in the Middle

middle of its Head, tapering to a Point, and turned in half a right Angle towards the Back, with an incurved Point; in every Respect exactly agreeing with the Horn of the Rhinoceros, which those of no other Beetle do.—I was unwilling my *Euphrosyne* should be unapprised of so beautiful a Curiosity of Nature, especially as I think it a *Non-descript*, for the latest Writers on Insects, not even *Linnaeus* himself, gives any Account of it.

Euphros. You take great Pains to oblige me, *Cleonicus*; and emulate Nature itself—for how lavishly has she arrayed this Animal, not an Inch long, in the rich Attire of Colours and splendid Ornaments in its Head, Breast, Wings, and Legs.—But particularly that curious little Horn makes this Scarab a valuable Curiosity.—Also, that *Target* or *Shield* over its Shoulders, embossed and embrowned with a Crimson Bronze, is wondrously fine, with all its variable Hues.—How richly are the Shoulders emblazoned with a greenish Yellow Tinge!—The Wings of a Cerulean Dye, nicely furrowed and dimpled.—But what an odd Sort of a Head it has, it seems to be a *Cap*, *Cleonicus*.

Cleon. It is truly a *Cap of Armour*, or *Helmet*; the same as the *Head Piece* on a *Coat of Armour*, worn by Warriors in Days of Yore.—What a polished circular Brim you see round the fore Part of it—in the middle of this (instead of *Plumage*) rises the Horn from a *Golden Ground*—two small Eyes, jetty Black, placed just behind—and the Mouth, Trunk, &c. quite beneath and out of Sight.—I advise you to place this among the Rarities in your little Museum, and then by Degrees my *Euphrosyne* may be able to shew what the Keepers of the *British Museum* cannot.—

Euphros. O fye, *Cleonicus*! I outvie the *British*, or rather, the *World's Magazine* of Rarities!

Cleon. No fye at all, my *Euphrosyne*.—It is impossible that any Collection should contain every Kind of Subject in the boundless Field of Natural Curiosities.—I will Wager a *Dish of Coffee* with you, that you do not find the *Green-Pea Beetle* in the *British Collection* of INSECTS; what do you say to that?

66 THE YOUNG GENTLEMAN

Euphros. How should I know what to say to it, till I have seen it, *Cleonicus*.

Cleon. Well, there it is, view it nicely.

Euphros. I do; but see nothing in it worthy the mention of a *Museum*—a small insignificant Scarab.

Cleon. I must confess, my *Euphrosyne*, it is too trifling in Appearance to attract the Eye of any Person but a *Virtuoso*; he always views Things with a Microscopic Eye, and so must you to be apprised of the Beauty and Native Elegance of this diminutive Creature.—There, I have placed it under a Compound Lens, now view it a second Time.

Euphros. I will.—On my Conscience I never saw a prettier Object.—You may well call it the *Green-Pea Beetle*, *Cleonicus*, as it appears to be bestrowed all over with very small Green Peas, or something like them—but to speak in a Style more worthy the Dignity of Nature, it appears to be a Scarab beset all over with fine small EMERALDS.

Cleon. But now view it through a deeper Compound, and you will plainly discover what it all is.—

Euphros. O, me, it is now magnified so much, that I can plainly see, that what before looked like little Emeralds, are only the Tops of oblong green Bodies, which grow by a Pedicle from the Surface of the whole Body—besides which I observe another Sort of Matter growing between, to keep them firm in their Positions.—In short, what you observed out of *Pliny*, *Cleonicus*, is here again confirmed, *That the Powers of Nature are no where so conspicuous as in her minutest Operations*.

Cleon. I shall now turn your Thoughts to another great Curiosity, my *Euphrosyne*, which to look at, you would not think to be of the Insect Nature, but the Microscope demonstrates it to be so.—I place it in the *Opake One*, as best for such a View—there, take it,

Euphros. I can plainly see it is an Insect of some Kind or other, *Cleonicus*; I can see an Oval corrugated Body—with circular Rings.—I see something very much like Legs, and a Head or Snout.—I see enough to convince me it is a small Insect like our *Lady Cow*.—I see in one Part,

Part, a little broken, that it is internally of a fine *purplish Colour*.—

Cleon. Now you have discovered all, my *Euphrosyne*—for it is nothing more nor less than that noble and valuable Drug which we call COCHINEAL, so much used in Dying Scarlet, *Crimson*, and *Purple*.—This enlightened Age has expunged many a vulgar Error, and among others this, *that Cochineal was the Grain or Seed of some foreign Vegetable*.—But now we are so well acquainted with it, as to know that the Manufacture of Cochineal in *Mexico* is as common and vulgar as the making of Honey and Bee's Wax is here.

Euphros. A short Sketch of that, *Cleonicus*, would be extremely agreeable to me.

Cleon. You will know then, my *Euphrosyne*, that Cochineal is the Female of an Insect, which feeds upon the *Opuntia*, or Indian-Fig of New Spain.—After becoming a Fly, some little time it fixes itself upon the Leaves of the Plant, and there continues till it has attained its utmost Perfection.—The Native Americans make a constant Trade of Breeding them in numerous and large Plantations of the *Opuntia*, having generally two or three Crops of them in a Year—and so great is that Branch of Commerce now, that it is computed there are eight or nine hundred thousand Pounds Weight imported from *Spanish America* in a Year.

Euphros. I thank you *Cleonicus* for this new Piece of Intelligence.—And is it, after all, owing to this contemptible Insect that we can dress away in such gaudy and gorgeous Array, that we shine in *Purple*, *Scarlet*, and *Crimson Vestments* in all the Glory and Pomp of Attire!

Cleon. What Species of human *Grandeur* does not originate from some low Subject, or despicable Creature, or another?—There is another Case similar to this, my *Euphrosyne*, and that is, the noted and useful Drug called *Kermes*; for this, too, is the Female of a Fly of that Name, which feeds upon the *Ilex*, or *Holm-Oak*;—These are of great Use in dying *Scarlet*, and still much greater in Medicine.—The Ancients thought it a most efficacious one; and there is still in our Shops the *Arabian Confection*

tion called *Alkermes*.—When the Female has laid her Eggs, which are very small and innumerable, she dies soon after, remaining fixed to the Spot where she was.—Her Body is a mere Case, serving to defend and cover the Eggs.—These being in Perfection, are gathered by the Women in the Morning in great Quantities,—are properly manufactured for Use—and imported in great Quantities from *France, Spain, Italy, and the Isles of the Archipelago*.

Euphros. I have heard our Nurses often talk of the wonderful Efficacy of their *Alkermes Confection* in their Way, but never had any Idea of an Insect being the principal Ingredient in it before.—I find, *Cleonicus*, when our Health declines, Nature has very benignly furnished us with *Restoratives* from every Class of Beings in the Creation, *Animal, Vegetable, and Mineral*.

Cleon. Your Reflection, my *Euphrosyne*, is just.—But it is Time now to advert to one other Predicament peculiar to this Tribe of Animals, and the most amazing of all, I mean their *Metamorphosis* or Change from one State of Life to another, and from one Form to another.—I can with Truth say what *Ovid* asserted in poetical Fiction only,

*Of Bodies changed to various Forms, I sing.

Euphros. This is so novel a Doctrine to me, that I scarcely know what you mean by it, *Cleonicus*; am I to understand that by the same Power who created one Animal, it is really changed into another?

Cleon. Yes, my *Euphrosyne*, that is the Mystery you are now to be initiated into.—*Pythagoras* taught a *Transmigration of Souls*, which he could by no Means prove true by Experiments.—*Ovid's Metamorphoses* are all *Fiction*.—But a *Transmutation of Forms* in numerous Species of Bodies, is an obvious Fact, which admits of Ocular Demonstration;—and not only a *single* Transmutation, but many successive Ones, in the same Animal or Insect.

Euphros. Well, *Cleonicus*, you talk of strange Things; but

but Facts, I find, are to familiarize them to me; so I shall become your Profolyte with the greatest Pleasure.

Cleon. I shall not enter into the Dispute among the Ancients, *which was first, the Hen or the Egg?*—but I shall take it for a decided Point, that not only the *Hen*, but every other *Animal* was originally contained in, and proceeded from an *Egg*, those of the *Polypus*-Kind only excepted.—You will know, therefore, my *Euphrosyne*, that the Changes both in Body and Form, are in some *three*, in others *four*, and some undergo *five* *Metamorphoses*. For (1.) The first or foetal State is that in the *Egg*. (2.) When the Foetus is mature, it bursts the Shell, or is hatched, generally in the Form of a *small Insect* which is called the *Nympha*, or else in the Form of a *Worm*, *Maggot*, *Caterpillar*, or *Grub*, which is called the *Eruca*. (3.) After the *Nympha* or *Eruca* comes to a mature State in that Form, it generally weaves itself a *Web Coffin*, and often a *long Case* with Rings tinged in part with Yellow, which is therefore called the *Aurelia* or *Chrysalis*; in this Case it continues its appointed Time, longer or shorter, and then is ushered into the World again in the Form of (4.) An *Aquatic Nympha* or *Eruca*, of various Forms and Kinds. After living in this Element its destined Period, it will throw off its present Covering, out of which will arise (5.) a most beautiful Insect of the *Gnat Kind*, the Female of which lays the same Eggs again as at first was mentioned.

Euphros. If I understand you right, *Cleonicus*, you insinuate that a *Gnat* goes through a series of five different Sorts of Lives, or at least, through Life in five various Forms of Animal Bodies.—And pray is not this a *Transmigration of Souls* in Insects?

Cleon. I cannot deny but that it is very much like it.—But my *Euphrosyne* is not to suppose every Insect undergoes all the five Changes; for some have only three; and most, but four of them.—I now intend to convince you of the Truth of all I have said by the Testimony of your own Senses. To begin then with those that undergo three States of Life, you must apply the Microscope to the Object I place before it.—There it is, what do you see?

Euphros. See, why I see a great Number of pretty little Animals upon a Green Leaf—they have six Legs, two Black Eyes, and two very long Feelers, which they ply about very quick as they move.

Cleon. And don't you see besides these, an innumerable Quantity of fine transparent pearly Atoms all over one Part of the Leaf?

Euphros. I do very distinctly; and more than that, I see they are all fixed on the Leaf by little Pedicles, as if they grew on it—but as I observe them only on this one Spot, I suppose *Cleonicus*, you will have me consider them as the Eggs of these Animalcules.

Cleon. Undoubtedly they are, my *Euphrosyne*, and that the Animals you see are in their *Nympha* State.—Now here is another Leaf, on which you see no Eggs; but many small Insects with Wings,—view them, my *Euphrosyne*.

Euphros. I will —Why they have Wings twice as long as their Bodies—very long Feelers, and very fine.—Six Legs and two Eyes—with the Bodies of some beautifully spotted.—But I see at the same Time numberless transparent small Skins of these Insects—I see their Bodies, Legs, and even the finest *Antennæ* at full Length—what do they mean *Cleonicus*?

Cleon. They are the (*Exuvia*, or) cast off Skins of the *Nymphæ*, when they assume their third Form, or that of the Fly.—These pellucid Skins are analogous to the *Aurelia* in other Insects.—These are the Animalcules which make what is usually called the *Blight* in Plants and Shrubs, whose Leaves so blighted, are all crumpled up, as this of the Currant-tree you now see.

Euphros. Now you speak of the *Blight*, *Cleonicus*, pray is not that little frothy Animal which I observe so frequently upon, and so much annoys the Beauty and Verdure of of the Plants in our Garden, to be reckoned a *Blight*?

Cleon. Hardly, my *Euphrosyne*; for though it does, by its *Froth*, greatly sully your *Woodbines*, *Golden Rod*, *Rosemary*, and other delicate Plants, yet it never destroys their Leaves or Flowers, as those we properly call *Blights* always do.—But this Insect is another Instance of the slight Regard we pay to the greatest singularities in the Works of Nature,—

Nature.—Instead of the detestable Epithet of *Blight*, the Philosopher looks upon it always with an awful Regard, and calls it the *singular Specimen* of creating Power.—The peculiar Art of defending itself from Injuries and Disturbance by a *FROTH* which it can throw over its Body at pleasure, is no where to be paralleled in the boundless Field of Creation that I know of.

Euphros. Well, but after all you have said of it, what is this wondrous Creature, *Cleonicus*?

Cleon. I will shew you, my *Euphrosyne*,—having taken off about half the Froth, you see the Animal, and its Art of supplying it through the Compound Lens.—

Euphros. I do with Pleasure now behold it, which I never did before.—I see and admire the Finger of Deity in this Animalcule!—I observe he constantly keeps throwing his Tail, part this Way and that, and every time I see the *Froth* come out in large Bubbles to cover itself withall.—I really thought till now the *Froth* had proceeded from its Mouth.

Cleon. But the noblest View of all, is the Method this Creature (or *Nympha*) takes to Metamorphose itself into a Moth, which you may observe at any Time, as follows:—After the *Froth* begins a little to subside, put it with the Leaf under the Glass.—The Froth degenerating to a White Film, fixes the *Nympha* to the Leaf—soon after this you will see the Moth first put out her Head—then proceeds the Body by degrees—as soon as the Shoulders are out, you will perceive a small Protuberance on each Side—these Protuberances, every Minute, grow larger and larger, till at last you will observe, they are the *Wings of the Moth* unfolding by degrees.—After one Quarter of an Hour the whole Change is effected—the Moth is liberated, its Wings are extended over its Body—and the fine Silver-looking Case of the *Nympha* remains in your View, with all its Legs, &c.—This whole Scene I have myself viewed with the highest Pleasure, and so will my *Euphrosyne*.

Euphros. I shall attempt it the first Opportunity *Cleonicus*;—Pray how many of these Kind of Lives have *Butterflies and Moths* in general?

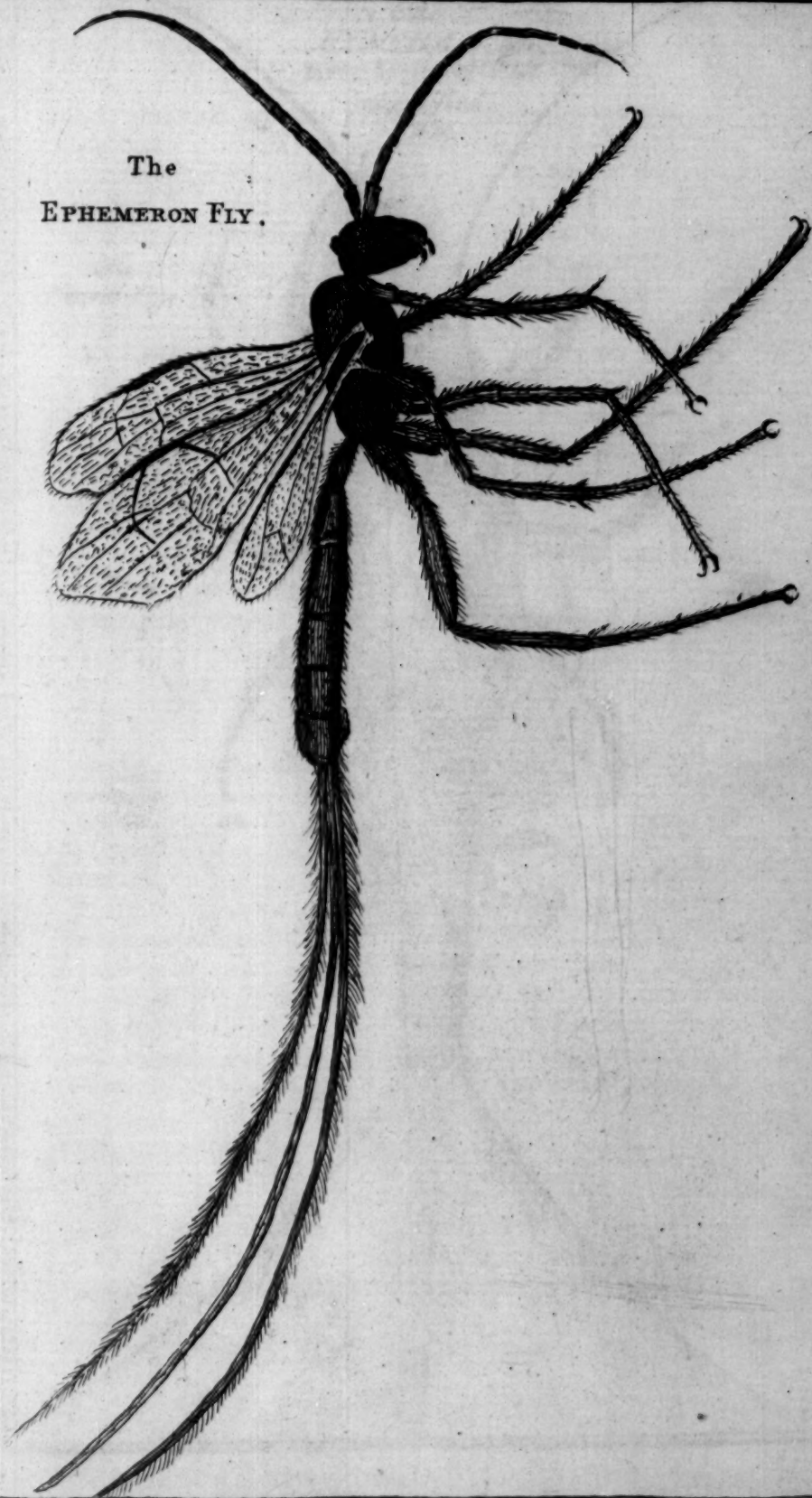
Cleon. Four, the *Fœtus* in the Egg, the *Caterpillar* or *Nympha*, the torpid State in the *Aurelia*, and the *Fly* which

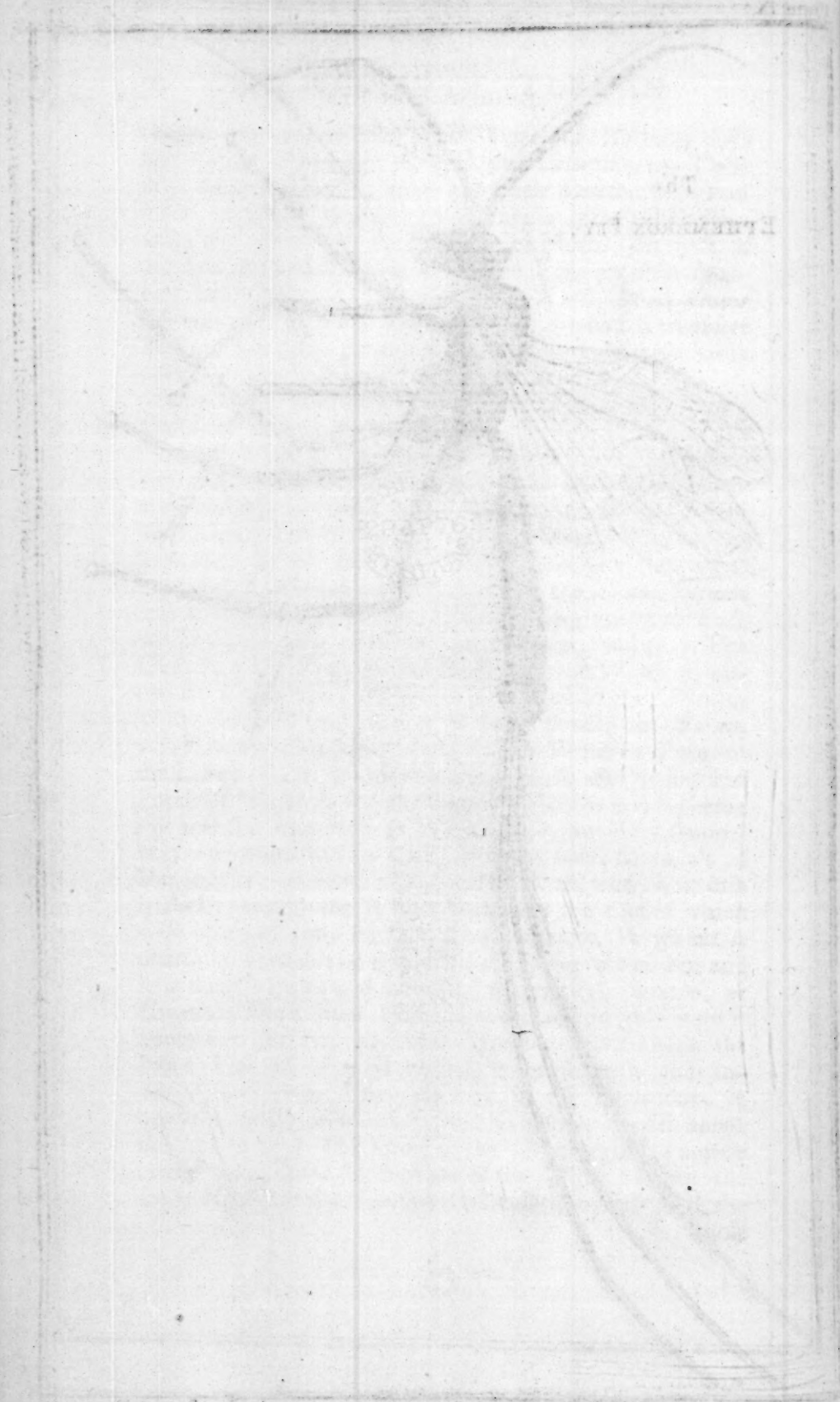
thence proceeds.—After some Time the Butterfly lays her Eggs.—These are hatched into *Caterpillars*.—These after the hot Months, spin from their Mouths a Sort of Web, in which they lie in the *Aurelia State* till Spring, and then comes out the Butterfly or Moth.—In most of the *Scarabs*, and common Flies, the Eggs produce *Mag-gots* and *Grubs*.—Those of Gnat-Kind, small *slender Worms*.—Of these last Animals, there are no less than five Metamorphoses.—And among these none so remarkably curious as the *Ephemeron GNAT*, or FLY.

Euphros. I have heard of this Insect, *Cleonicus*, being famed for living but *one Day*.

Cleon. That is the common Opinion my *Euphrosyne*, but the Truth is, that instead of a *whole Day*, there are very few of those Gnats that live more than five or six Hours after they attain their Fly-State.—For having kept them by me in Pans of Water for near two Years together, I observed very particularly, the several Periods and Changes it passed through from Beginning to End, which I shall now relate to you in Order, and (1.) The Gnat lays her Eggs on the Surface of the Water in numerous Clusters, which are soon hatched by the Warmth of the Air into (2.) *Erucae* or small slender red *Worms*, which throw themselves along in the Water in Form of the Letter S; as you may observe them in all Puddles and Ponds of Water during the Summer Months every where; towards the Approach of Winter, this provident Animal begins to make itself a Case, with the finest Materials of Vegetables and Earth mixed and glued together,—in this it abides through the Winter Season, at the End of which it is changed into its (3.) *Chrysalis* State, in which it continues dormant or torpid till the *Spring* comes on, and it is then transformed into (4.) a beautiful *Nympha*, or Creature, like a small Fish, almost; and in this State it continues for two or three Months, when about the latter End of May it begins to be sluggish and inactive, and about three o'Clock in the Afternoon, it becomes nearly motionless, and so continues till about five, when (5.) The Head of the Gnat begins to appear gently rising above the Surface of the Water;—then the Body slowly ascends near perpendicularly upright, till the whole

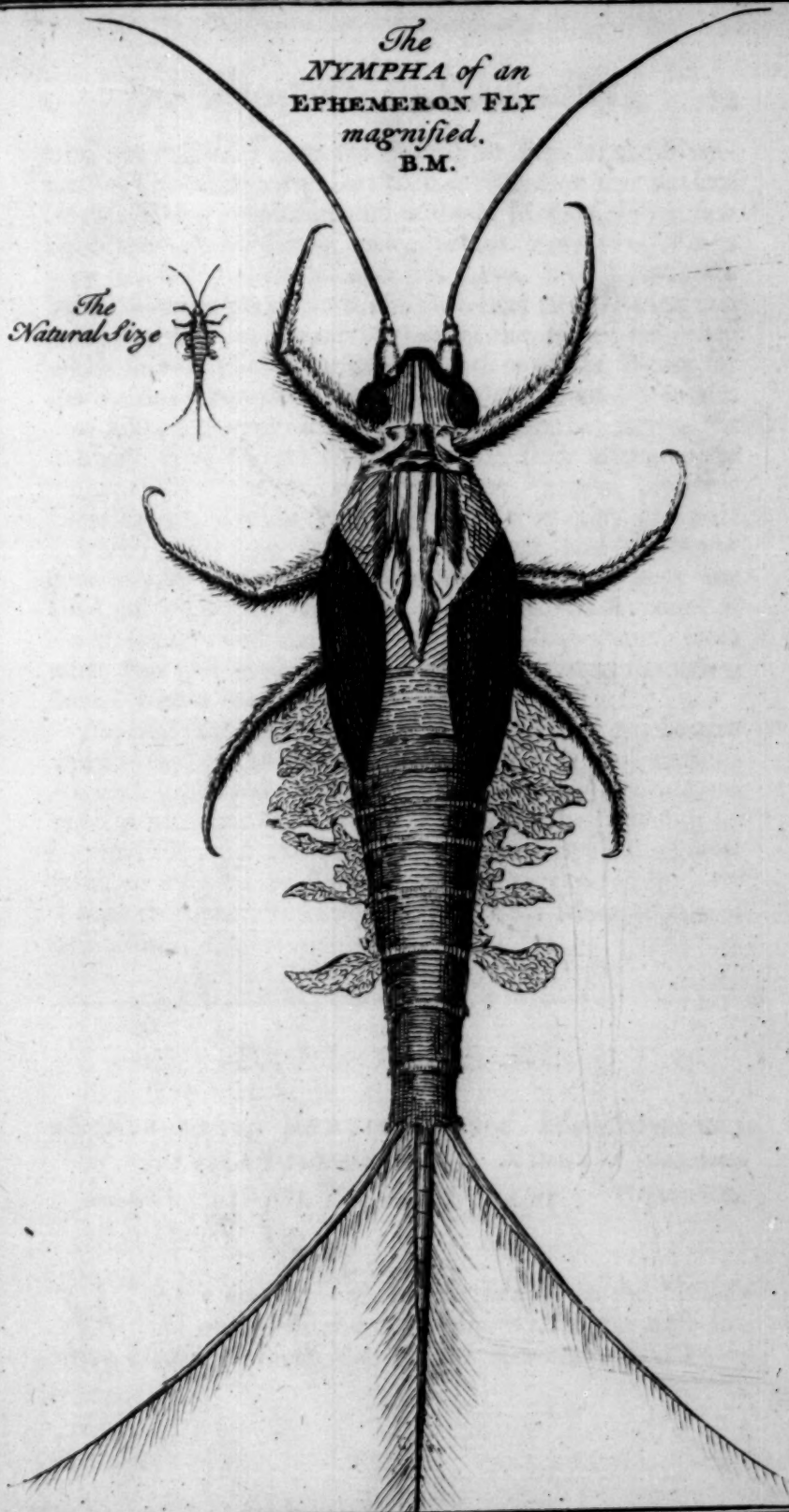
The
EPHEMERON FLY.

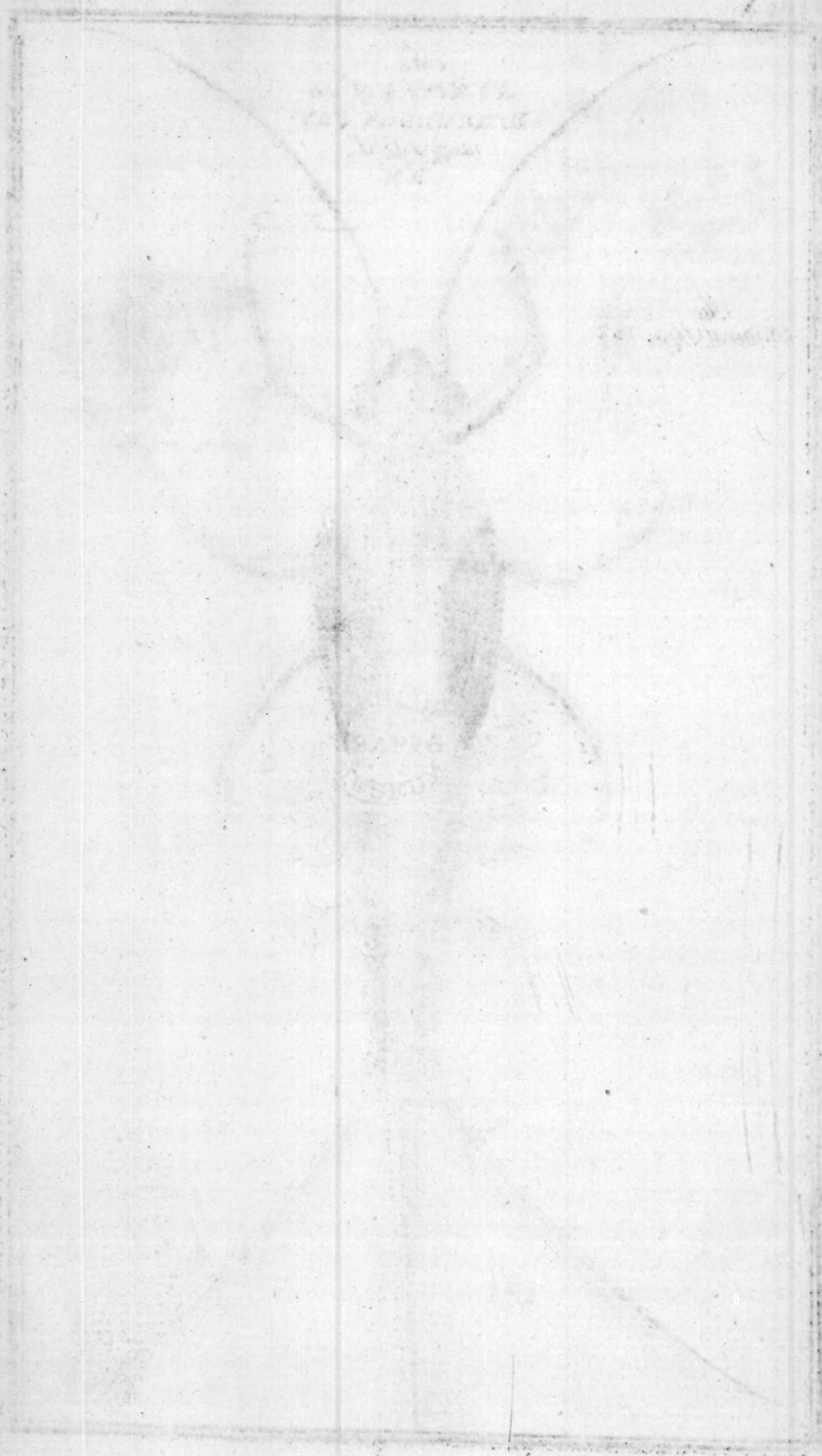




The
NYMPHA of an
EPHEMERON FLY
magnified.
B.M.

The
Natural Size





whole be excluded from the *Exuviae* or Skin of the Nympha.—The new-born *Gnat* then falls flat on the Surface of the Water, and remains without Motion for a few Minutes.—About six o'Clock it begins to move its Wings very tenderly, then rises on its Legs, and flutters its Wings—attempts to walk, and soon after to fly.—And this being the Case of several of them at the same time, they will frisk and play about on the Surface of the Water for the Space of near two Hours—the Males and Females now find each other out, and associate together from eight to about nine o'Clock.—Then pursue their promiscuous flighty Dance, as before;—then the Females lay their Eggs about ten o'Clock—after which they play and part a while, then drop down dead at once, and all expire generally by eleven o'Clock at Night.—I once kept one alive till twelve the next Day.—I know this Account of the *Ephemeron* and its Transmutations, differs much from what you will find, my *Euphrosyne*, in reading Authors, but all I have now avered, I know to be Fact.

Euphros. I thank my *Cleonicus*, for giving me so true and so explicit an Idea of this wonderful and curious Animal, under all its Variety of Lives and Forms.—I have learnt already that nothing is *great* or *small* but by Comparison, so I can conceive a Life of five Hours may seem as long to an *Ephemeron* Fly, as the Life of fifty Years to a Man, as both vanish together when compared to Eternity.

DIALOGUE XI.

Of SERPENTS, REPTILES, and MULTIPLEDES;
of the RATTLE-SNAKE; VIPER; common
SNAKE; SNAIL; CATERPILLAR; BOMBYX,
or SILK-WORM.

Cleonicus.

WE are now arrived, my *Euphrosyne* in the Course of our Meditations on *Animals*, to the most inferior Orders of them, that is, the REPTILES and SERPENTS,

PENTS, whose Motion is performed with *many Feet*, or by *few*, or by none at all, but which push themselves forward by a sinuous Bending and Turning of the Body, this way and that, as they proceed; and this latter Sort we properly call *Serpents*, and the other which move with *many Feet*, we call *Centipedes*, *Multipedes*, &c.

Euphros. I make no doubt, *Cleonicus*, but even those Animals, the very Name and Sight of which make one shudder, will afford very copious and convincing Lessons of that Divine Doctrine, *the Wisdom of God in the Works of Creation and Providence*, and as such I shall be very attentive to what you say.

Cleon. We shall begin with the Capital Creature of this kind, the SERPENT, of which there are many different Species and Sizes, both on Land and in Water.—Some of these are very *poisonous*, as the *Rattle-Snake*, and the common *Viper* or *Adder*,—some have no Poison, and are very innocent, as the common *Snake*, *Slow-Worm*, &c.

Euphros. Pray, *Cleonicus*, can you give me any Idea how this *sinuous Motion* of Serpents is performed?

Cleon. I will endeavour to do it to your Satisfaction, I hope, my *Euphrosyne*.—In the first Place you will know that the Bodies of Serpents are covered with pretty large *Scales*, as you see plainly enough in the Snake or Viper.—*2d*, These Scales lie *across the Belly* contrary to those on the Back, and other Parts of the Body.—*3dly*, These Scales have each their particular Muscles, by which they can be moved or raised a little from the Body.—*4thly*, The Edges of these Scales successively so raised one after another, become a Sort of short Feet, by which they can insinuate or bear themselves, with great Force forward.—*5thly*, The Muscles of the whole Body are of such a peculiar Form and Disposition as to Favour or rather produce that sinuous Motion we speak off.—*6thly*, The peculiar Articulation of the *Vertebrae*, or Bones which compose the Spine of a Serpent, are the most proper for such a Motion that can be, for they are *round* at one End and *hollow* on the other, so that they move in each other every Way, like a Ball in a Socket; and therefore conspire with every other Part to Produce such a *sinuous Motion*.

Euphros.

Euphros. I am quite satisfied in that Point, *Cleonicus*; I find they not only move with great Force upon the Surface of the Earth, but also that they can climb up Trees, and twining their Tails round the Boughs, can extend their Bodies and Heads a great way round, to take their Prey within Reach.—I find in *Virgil*, *Ovid*, *Horace*, *Lucan*, *Homer*, and many other Poets, very moving and beautiful Descriptions of this monstrous and tremendous Creature—particularly that of *Homer*, which *Pope* thus Versifies.

*The Atlars heav'd, and from the trembling Ground,
A mighty Dragon shot of dire portent,
From Fove himself the dreadful Sign was sent;
Straight to the Tree his sanguine Spires he roll'd,
And curl'd around in many a winding Fold.
The topmost Branch a Mother Bird possess'd,
Eight callow Infants fill'd the Mossy Nest;
Herself the ninth, the Serpent as he hung,
Stretch'd his Black Jaws, and crush'd the crying young.
While hov'ring near, with miserable Moan
The drooping Mother wail'd her Children gone;
The Mother last, as round the Nest she flew,
Seiz'd by the beating Wing, the Monster flew.*

POPE'S *Ilia*'.

Cleon. You'll find by sacred and prophane History, that the largest Sort of Serpents have always been represented as *Dragons* and *Monsters*, and under other terrific Characters, which have impressed Mankind with irresistible fear and dread of approaching them; and it is worthy Observation, my *Euphrosyne*, that the most dreadful Species of all, carries in his Tail an *Alarm Bell*, or *RATTLE*, to give Notice to his Prey of his Approach, and thereby an Opportunity of getting, if possible, out of the Way.

Euphros. This must be regarded as a most evident Proof of a providential Design, in the Original Formation of this Creature.—It is from thence I suppose, called the *Rattle-Snake*.—But pray, *Cleonicus*, what does this Rattle consist in?

Cleon. It consists of several hard, firm, and horn-like Pouches, which are articulated one within another, in
such

such a Manner, and so loosely, that they strike against each other, and make a Rattling Noise, whenever the Serpent vibrates his Tail, for they are placed upon the End of it for that Purpose.

Euphros. Pray, *Cleonicus*, how large a Size do they grow to?

Cleon. The Size of the Rattle-Snake is enormous, my *Euphrosyne*; I have seen the Skin of One upwards of twenty-one Feet long, and about four Inches thick; it was so nicely stuffed as to represent the Life, and it struck me with Horror to view it.—But I have read of some that are of a much larger Size.—They are not apt to be mischievous, but when they are offended, or trod upon.

Euphros. The Poison of Vipers, is from the Bite, I have heard, *Cleonicus*, and not a Sting, as in Insects.

Cleon. It is true, my *Euphrosyne*, the Poison of Serpents is contained in a Bag, in the Gums, at the upper End of the Teeth—it is secreted from the Blood by a proper Gland, and conveyed in a Duct to the Bags.—The Teeth are tubulated for receiving the Poison.—And sharp pointed for making the Wound—a little below the Point is a long Slit, through which the Poison is emitted into the Wound.—The Poison of Vipers is of great Use to enable them to secure their Prey, and to digest it when devoured.—The Flesh of Vipers is of the highest Estimation and Use in Physic, as boiled in Broth, infused in Wine, or eaten like that of Eels.

Euphros. Is there any Truth in the Story which I have also heard *Cleonicus*, that the Rattle-Snake is possessed of a Power of making small Animals, as Mice, &c. jump into its Mouth, by a sort of Enchantment.

Cleon. I know this, my *Euphrosyne*, that People of great Credit have affirmed that they have seen them do it often, but they vary in their Accounts of this fascinating Power; some averring it consists in a Sort of Halitus or Breath issuing from their Mouths; but others think it owing to fixing their Eyes, with a horrid Glare upon the little Mouse, till it begins to quiver and shake, and with Shreiks, and Cries advances towards the open Mouth of the Serpent, and then jumps as it were by Enchantment, (as you say,) into the same

Euphros.

Euphros. How miserable such a Sight as that would make me! What strange Things are to be found in Nature! pray, *Cleonicus*, does the Serpent always move in a prone Posture, or with any Part of its Body erect at any Time?

Cleon. It moves in either Mode at Pleasure, my *Euphrosyne*; but more seldom in the latter, unless when he wants to see a good Way about him.—He then glides along on his hinder Part, with his Head upraised; and brandishing his forked Tongue, with a hissing Noise, when enraged.

Euphros. Pray what are those called *fiery flying Serpents* that we read of?

Cleon. The *fiery Serpent* may be so called, perhaps, from its high, shining, Golden Colour, in some Parts; thus the Poet;

*Above, all fierce her glittering Volumes rise,
Flames in her Crest, and Lightning in her Eyes.*

(speaking of a Serpent bruised and mangled by an unfeeling cruel Swain.)—As for a *Flying Serpent*, I never met with any in my Reading upon *Natural History*.

Euphros. By what you have now related, *Cleonicus*, I fancy a Serpent of the larger Sort must make a very Noble and Majestic Figure, when seen to the greatest Advantage.

Cleon. So much to Admiration, that he has always been thought the *wisest* of all Animals; and even adored as a *Deity* among the *Egyptians*, and many other Eastern Nations.—To say the Truth, my *Euphrosyne*, there are many of the *Coluber* Species of Serpents so finely speckled, striped, and bedecked with Variety of Colours, as scarcely to have their Parallel in any other Part of the Creation.

Euphros. Well, I think I have had a long Lesson on *Serpentine Philosophy*, *Cleonicus*, but give me leave to ask one Question more, is there any real Difference between a *Serpent* and a *Snake*?

Cleon. A SNAKE is a Serpent undoubtedly, yet differs from the Viper-kind in two or three Essential Points; for (1.) a *Snake* is not venomous, as all *Vipers* are.—(2.) *Snakes* are

are hatched from Eggs, but Vipers are born alive (3.) Snakes are generally spotted Black and White, whereas Vipers are more of a Bronze or Yellowish Hue, with long black or dark Streaks along their Bodies.—(4.) The larger Serpents have *Scuta* or Shield-like covering on the Back and fore Part of the Body, and Scales on the Belly and Tails only, whereas a Snake is covered with Scales all over.—And so much for Serpents, my *Euphrosyne*; now a few Words concerning *Reptiles*, and we have done.

Euphros. Pray, *Cleonicus*, what do you properly call a Reptile?

Cleon. Any Thing that *creeps* or *crawls* along with many small Feet, and therefore they are generally called *Multipedes*. Indeed many of this Tribe have been called *Centipedes*, as if they had a hundred Feet; and sometimes *Millepedes*, a thousand Feet, that is, any Animal with a great Number of Feet; such as *Wood-Lice*, *Caterpillars*, *Snails*, *Worms*, nay, all the *Lizard-Kind*; for though they have but four Feet, yet they move by *creeping* and *crawling* along—in short, my *Euphrosyne*, the Modes of moving in these Creatures are so peculiar and anomalous, that there is no reducing them to any certain Rule. Thus *Snails*, as having no *distinct* Legs, can't properly be said to *crawl* or *creep*, yet they may be said to *glide* along.

Euphros. Your saying *SNAILS* have no *distinct* Legs, *Cleonicus*, seems to imply they have Legs of some sort or other.

Cleon. There may be observed in the Sides of the Snail an evident Motion of Parts, which though contained in one continued mucilaginous Membrane, yet may be considered as so many Feet acting in Succession, and by the external roughness of the Skin, produce a Motion, and carry the Snail gradually forward.

Euphros. Pray, *Cleonicus*, are those Black Spots that we see on the End of the Horns of the Snails, the real Eyes of that Creature?

Cleon. Undoubtedly, my *Euphrosyne*; apply any Object to within an Inch of them, and you will perceive that they see it, by their withdrawing them immediately into their Head;—this is so wonderful a Faculty as is not to be observed in any other Animal that I know of.—As
Snails

Snails have four Horns, so they have four moveable Eyes of Course—two on the long Horns raised high to see round about them; and two on the short Horns below to see any Thing near their Head.

Euphros. A wonderful Provision this, for a Creature that moves so slow! And what I think still more a Mark of divine Design, is to find it endued with a Power of contracting it's Body into a *shell* that it constantly carries about him, when he perceives himself assaulted or obstructed in his Passage—I fancy the Snail has Teeth and Jaws, *Cleonicus*, by his readily and speedily devouring green Leaves and Herbage.

Cleon. He has very strong and sharp Teeth, like Caterpillars, and other Reptiles, which devour the Leaves and Blossoms of your finest Plants and Flowers, to the great annoyance of the Garden.—These Teeth may be seen while the Snail is feeding, if my *Euphrosyne* will take the Trouble to view them with her *Explorator*; applied in a proper Manner.

Euphros. I have so great an aversion to these Animals, *Cleonicus*, that I shall take your Word for it.

Cleon. If you are so averse to them, 'tis happy for you, that you are not obliged to *eat them*, as many are, for *Consumptive Disorders*, for they afford the best of Nourishment.

Euphros. Happy indeed, *Cleonicus*; I am willing to leave the further Consideration of this melancholy Subject to the *Naturalist* and *Invalid*—I fear this *Reptile Race* does not abound in many chearful and exilering Subjects.

Cleon. Hey dey, my *Euphrosyne*, you are in the *Hyp* all at once! Is there any Thing in Nature but what is *beautiful* and even *striking*, when rightly considered? Come turn your Eye to the Pride of Nature, the small Caterpillar I have just taken up in the Garden—look at it with your Compound Lens—and you must confess that it is a rich and noble Work of God.

Euphros. I never saw a Caterpillar in this Light before—How richly is it adorned with Colours, Black, Red, Yellow, White, &c! What beautiful Tufts of Hair do I see in several Parts of the Body!—Four curious round Tufts upon it's Back, all of equal Size, and at an equal Distance,

Distance, just like the Hair in my finest Brushes—again, two long Tufts of Hair upon it's Head, which look like Feelers in Insects; these, too, are brushy and Black at the Ends, and of different Lengths—two more such long Tufts, one on each Side—and one more the same at the Tail.—What regular and beautiful Ringlets compose the Body, studded with hairy Knobs of various Hues!—No Ermine is half so rich and finely spotted!—How do you account for so much *gaudiness* and *genuine Finery* in a Creature of this lowest, this most contemptible Class, *Cleonicus*?

Cleon. The Works of Omnipotence are all unaccountable, my *Euphrosyne*, except some that relate to the Oeconomy and Preservation of the Species and Order of Beings—but you have not yet surveyed all the Wonders of this Reptile; look next at the Feet, and tell me how many you find.——

Euphros. I will, *Cleonicus*;—I see six at the Part next the Head, three on each Side; these have single and sharp pointed Claws, of a Tortoiseshell Colour—upon the middle Part of the Body, I observe eight Legs, four of a Side, but these are very different from the other, having a Sort of round, Concave Feet, the Rims of which seem divided into many small Parts like Toes; by these I suppose they are able to take fast hold on every Thing they crawl upon.—On the very End, or Tail, I see two more, the same with those at the Head.—In the whole, this Reptile has sixteen Legs; eight of two different Sorts.—Have I rightly answered your Command, *Cleonicus*?

Cleon. Precisely well, my *Euphrosyne*. There are many other Sorts and Species of Caterpillars, which, at times, you will find in the Garden, and in like Manner, may examine at your Leisure—some are very hairy all over—others have no Hair at all.—But they all have the *Faculty of spinning a fine Silk*, the Treads of which they draw out of their *Mouths*, as the *Spiders* do theirs from their *Posteriors*.—The *Spider* spins his Web entirely with his *Feet*, the *Caterpillars* with the *Mouth* only.—The *Spider's* Web is to en'nare his Prey.—That of a *Caterpillar* serves him for a Rope to descend from the Branches of Trees to the Ground

Ground. — He also spins himself a Ladder against the Walls and Windows of the House, by which he climbs to the Top, and gets into Holes——and there he makes his *filken Sepulchre*, in which he deposits the Remains of the Caterpillar or *Nympha*, and assumes the *Aurelia* State.

Euphros. I find *Cleonicus*, that every Thing hitherto observed of *Caterpillars*, is applicable to the *Silk-Worm*, and that this most celebrated and useful Reptile, to whom we owe the greatest Part of our rich and most valuable Cloathing, is nothing but a mere *Caterpillar*, and that the *filken Balls* or *Cases*, in which it entombs itself, are the Materials of all the *Silk Manufactories* in the World; and the Moth which produces them, lays her Eggs on the Branches and Leaves of *Mullberry Trees*, on which these Silky-Caterpillars feed, to the Time appointed for their Change.——But why is not the Silk of other Caterpillars used also?

Cleon. I suppose the Reason of that is, because no others produce it in sufficient Quantity; they generally finish their Cases in two or three Days, and but very thin ones—but the *Bombyx* or Silk Worm, my *Euphrosyne*, is at least ten Days in finishing her funeral Tomb; and it is so very thick, that were it unravelled into a *stroit Line*, it would be *six Miles* in length—then as to it's Strength, it is found that one Silk Thread of the *Bombyx*, is equal to five of those from the Spider, and much larger than the Silk of any other *Caterpillar*.—But as there are some curious Books wrote upon this Subject, I shall procure them for your further Information, and so for the present *Adieu*.

DIALOGUE XII.

The foregoing SUBJECT continued: Of the ANT-LION; CENTIPEE; MULTIPEDE or WOOD-LOUSE; of EFTS, and LIZARDS; of the CROCODILE and ALLIGATOR; of the CAMELION: of the EARTH-WORM.

Cleonicus.

THE present Hour, my *Euphrosyne*, will carry us through our Contemplations on REPTILES.—Common Subjects of this Class are endless, but a few striking Specimens still remain to excite in our Minds further Conviction of the astonishing Wisdom, Contrivance, and Design employed in the Formation of many Individuals of this low Species of Beings.

Euphros. I think my Time never so nobly employed, as when I am in the Contemplation of some signal Operation of Nature, for be the Subject what it will, it is equally grand, equally sublime to me—therefore pray tell me, *Cleonicus*, what I am next to admire in the Scene of Reptiles.

Cleon. Something that I am sure will delight my *Euphrosyne*—it is not only an oddity, but, I believe, a singularity in the Works of Nature—for whereas almost all Animals, when they move at all, move *strait forward*—very few indeed, move *sideways*, like the *Crab*—but none in Nature that moves *backward only*, but that Creature which Naturalists call the *Formica Leo*, or ANT-LION, which, if it were to save it's Life, would never move a *Step forward*.

Euphros. I am lost in wonder and amazement, when I take a Survey not only of the *Infinity*, but also of the *Diversity* of the Works of the Deity!—An Animal doomed to go *backward*, one would think must always recede from, instead of pursuing it's Prey, and so, of Course, be soon starved.—By what Art can it preserve it's Existence, *Cleonicus*?

Cleon:

Cleon. All Things are possible to the divine Creator—Animals of all Forms, and Modes of Movement may have the Means of Life accommodated thereto.—It would puzzle my *Euphrosyne*, or me, to think of a Method by which such a Creature can very readily catch and devour Ants and other Insects.—And to hold you no longer in suspense, it is briefly thus; the *Ant-Lion* seeks a sandy Soil, and having found a Place in fine flowing Sand, it begins to go round and round with a circular *retrograde* Motion, throwing up the Sand to the Top, 'till, by contracting it's Circles, or rather Spirals, it makes itself a Hole in the Sand of about three Inches Depth, in the Form of a *Funnel*—it is also about three Inches wide at the Top, and at the narrow Bottom a Hole is made, a little more than big enough to receive it's Body, and the Earth hollowed away below that—at the Bottom of this Funnel it lies very snug, with it's Head and Forceps in the Hole, expecting every Minute it's Prey to come to it.

Euphros. To come to it, *Cleonicus*!—What, by a Charm! or what other Way?—But I believe I guess how the Case stands.—The *Ant* (with all her Wisdom) I always looked upon as a giddy-headed Mortal, running this Way and that, and every Way, 'till it comes to the sandy Precipice, on the Brink of which, the treacherous Sand giving way, it immediately slides down the Side of the Funnel, and, consequently, into the voracious Jaws of the Insect-Lion.—Is not this the Case, *Cleonicus*?

Cleon. You have hit it off to a Tittle, my *Euphrosyne*.—That is the Artifice employed by sagacious Nature to supply this (otherwise) helpless Animal to it's Food, since not only Ants, but many other small Animals in their casual Excursions, run upon the same sandy Precipice, and inevitably fall into the Mouth of the Lion.—But still there remains a more wonderful Part of the Story.—

Euphros. Indeed, *Cleonicus*! Pray let me know what that is—for I am sure I can't guess it out as I did before.

Cleon. I believe as much, my *Euphrosyne*, you must be inspired to do that, as much as the Animal is itself to exert such a strange Degree of Force and Art as it is obliged to do on some Occasions.—For the Case is this, when any winged Insect happens to settle on the Edge of the Funnel

and glides down to the Bottom, it endeavours to recover itself by flying up. but it is soon prevented making it's Escape that Way, by a Volley of Sand which follows it, like Stones, and beats it down with great Precipitation to the Bottom of the Funnel, where it becomes the little Lion's Prey.

Euphros. Well, if ever I heard the like of this, *Cleonicus* ! Whence has this Creature the Power of raising such a storm of Sand about the Ears of the Fly ! How does it know that Particles of Sand can have Force enough to beat it down again into the Pit of Destruction !

Cleon. This Force and this Sagacity in the Creature, is all of divine Original.—Animals are but a Sort of living Machines.—They act their Parts on the Stage of Life like so many Puppets in a Show ; like the Sawyers, the Carpenters, and Coachmen, &c. which you see daily at Work in the Clocks in *St. Martin's-Court*.—Any Time-Piece may be made to shew the Hour by an Index or Hand that goes *backwards*, just as well as by one that goes *forward*, in the common Way.—All the mere Animal Creation seem designed to answer one common great Purpose, that is, To declare the Glory of God, in Specimens of his Hand-Work.

Euphros. Well, but after all, what is this wonderful Animal, this divine Machine, as you call it, *Cleonicus* ?

Cleon. Why truly, my *Euphrosyne*, it is nothing more than a *Caterpillar* of a large Fly, somewhat like the *Libella* or Dragon-Fly.—All these marvellous Particulars of this curious retrograde Oddity of Nature I received from a Gentleman, who with great assiduity attended to all it's Motions and Actions for the whole Period of it's Life.—He said the Creature was sometimes unlucky, and could meet with no Prey for a whole Day, sometimes not in a Week, or Fortnight ; but it appeared very patient of Hunger, and never quitted it's Station at the lowest Part of the Funnel.—At length it prepared for the *Aurelia State*, and was no more the *Formica Leo*.

Euphros. With what Pleasure, and Astonishment do I hear such Natural Histories as these !—Pray *Cleonicus* what is the next striking Object among Reptiles, that require my Attention ?

Cleon.

Cleon. That Creature which is most properly called a *Reptile*, or *creeping Thing*, I mean the *CENTIPEE*, whose Motion is wonderful, if well considered, being produced by the regular and successive Motion of a great Number of Feet on each Side of it's small long Body.—Concerning this Affair the late *Dr. Derham* has this Observation:

“It is a wonderful Mechanism, observable in the going of *Multipedes*, as in the *Scolopendra*, &c. that on each Side of the Body every Leg has it's Motion, one very regularly following the other, from one End of the Body to the other, in a Way not easily to be described in Words; so that their Legs in going, make a Kind of *Undulation*, and give the Body a swifter Progression than one would imagine it could have, where so many Feet are to take so many short Steps.”

Euphros. I have oftentimes admired that strange yet pleasing Motion, from such a Multitude of small Legs on both Sides of the Body.—Pray, *Cleonicus*, what Number of these short Legs may there be, in those which have most of all?

Cleon. I think Naturalists have counted between thirty and forty on a Side, my *Euphrosyne*, but some have more and some a less Number—the common *Multipedes* or *Wood-Lice* (which are of such great Repute in Medicine,) you know very well have but eight of a Side, or sixteen upon the whole—their Bodies are covered with several narrow Cases, which lie a little over each other, so that the Animal, when disturbed, can roll itself up into a round Ball, and thereby can be easily swallowed as a *Pill* by those who are obliged to take them for their Health-Sake.

Euphros. Our Disorders are many-fold, 'tis true, but Providence makes almost every Thing a Remedy for some or other of them.—Is there any Thing further remarkable in this Order of Reptiles, *Cleonicus*?

Cleon. Yes, my *Euphrosyne*, we must not omit that very extraordinary Case, where some of this Species are found to be perfect *Noctilucae*, or to shine in the dark Night, like Sticks of *Phosphorus* about an Inch long, upon the Path where you are Walking—I don't know if you ever observed them, but I have often;—I have also taken them up,

put them into a Box, and the next Morning, found them to be most curious slender *Centipees*.

Euphros. Pray, *Cleonicus*, what Order of Beings do you reckon *Lizards* to be of?

Cleon. As they move by *creeping and crawling*, they must be deemed *Reptiles*, though they have but four Legs, and five Toes upon each Foot.—Of this Species are all *Efts* or *Newts*, so commonly seen in the Summer Time: Nay even the Crocodile or *Allegator* must be considered as only a very large Lizard or *Newt*, being in general made every Way like them.

Euphros. These are really striking Objects, *Cleonicus*; for they never fail to strike me with great Fear and Dread, whenever I see them.—And yet, (who could believe it?) a Lady that I sometimes visit, keeps a Green Lizard for her Amusement; nay even lets the Creature run over her *Body, Breasts, Arms, &c.* It makes me sweat to think of it.—I am as much afraid of it when I go there, as some People are of a *Cat*.—

Cleon. I don't wonder at it, my *Euphrosyne*, at all.—I had at first a great Aversion to *Water Newts*, till I was obliged frequently to put them into Glafs Tubes for shewing the Circulation of the Blood in their Tails; and they then became very familiar to me, as the Lizard to the Lady you mention.—But were you to see a Crocodile, I should not wonder at your being a little scared.

Euphros. I believe it would not be a little, *Cleonicus*, if I was to see one as large as I have heard talk of, eighteen or twenty Feet long.

Cleon. And some are much larger than that, if we believe Travellers; however, this is certain, that they are of a monstrous Size, and live on Land and in Water.—They are very numerous in all the great Rivers in the *East Indies* and *America*.—They live chiefly upon Fish, and any land Animal they can seize.—Are particularly fond of Human Flesh and Blood; and often catch up little Children, when strolling at a Distance from the Cottages near the Rivers.—Also too often they seize on Persons in Canoes going upon the River.—For these Purposes they lie in Ambush in Sedge, Reeds, Rushes, &c. which grow thick by the Sides of those Rivers.—When they seize

seize any living Prey, they plunge with it to the Bottom of the River till it is drowned, and then come up and eat it above Water.—They move very fast forward, but turn very slowly round, so that the Prey often escapes by that Means.—Their Mouth is very long and pointed like a Fish's, beset with serrated, strong, sharp-pointed Teeth.—Their Bodies are covered with a Sort of Mail, but not impenetrable, the Tail-Part with a Sort of Scales like the Tiles on a House.—The fore Feet are somewhat shorter, than the hinder ones, and have five Claws with sharp pointed Nails; the hinder Feet have four Toes only on each Paw.—They are of a dark Brown Colour like Mud, and are not easily discerned from it, which makes them the more dangerous.—They are bred from Eggs buried in the Sand, and hatched by the Sun's Heat.—The *Allegator* is a Sort of Crocodile, and has a strong scent of *Musk*.

Euphros. The Account you have given *Cleonicus*, agrees exactly with what I saw exhibited by way of Show in *Cockspur-Street* sometime ago, where a small Crocodile alive in a Tub of Water, was so far magnified by a large Concave Speculum, as to appear at least twenty Feet long; and this was enough for me, for I never saw such a horrible Appearance in my Life.—Is there any thing more, after this, worth Notice in the *Reptile Class*?

Cleon. Yes, my *Euphrosyne*, you have heard many a time of that curious Animal, called the *Camelion*.—

Euphros. I have, *Cleonicus*;—That it lives by the Air—changes its Colours at Pleasure, &c.

Cleon. These Stories favour too much of Romance, my *Euphrosyne*,—the Truth is, this Animal is not perfectly of the *Lizard Kind*.—And Nature has furnished it with a long small Tongue which it throws out of its mouth along upon its Back, which small Flies settle upon, and stick to, and are then drawn into its Mouth for Food, and this is its Way of Life.—Then as to its voluntary *Change of Colours*, I think it too much like the Pretence of *Feeling Colours*, to be true.—The Colour of this Animal is an exquisitely *fine Green*; on the most esteemed Sort, they are spotted with Yellow, Brown, &c.—They have various Eminencies all over their Bodies, studded with small Knobs like Pearls, and Gems, which placed in a proper Light

give them a most rich and brilliant Appearance.—The Eyes of this Creature resemble a deep *Lens*, set in a versatile Socket, which by a peculiar Mechanism of Muscles, it can turn forwards, sideways, and backward, so as to see every way and every Thing about it.—Yea, so singular is the Faculty of Vision here, that the CAMELION can look forward with one Eye, and backward with the other, at the same time; that it can look upon the Ground, and into the Heavens, at once, without turning the Head, which is fixed to the Shoulders.—There are many inferior Sorts of Camelions, not worth reciting to you, as my Design is only to bring you acquainted with the most extraordinary and principal in each Class of Objects which Nature has proposed for our Scrutiny, and Admiration.

Euphros. O, that every *Euphrosyne* who had a Brother, had one so obliging! But don't let me tire you any longer at this time, *Cleonicus*.

Cleon. I have only one Reptile more to amuse my *Euphrosyne* with for a Conclusion.—And what should that be but the *Earth-Worm*.—A Theme truly low indeed, you will say.—But the *divine Wisdom* displayed in its wonderful *Fabric* and singular *Mode* of Life, has sufficiently elevated it to the Contemplation of the greatest Sages of the Age, *Willis*, *Tyson*, *Derham*, &c.—The Compages of its whole Body is a concatenation of *Annular* or rather *Spiral Muscles*.—The Head furnished with a Sort of Snout or short *Proboscis*, (like the Worm of an Augre) by which it can bore it's Way forcibly into the Earth.—The several Rings of its Body are very rough, by which, as by small Feet, it moves along—the fore Part has pointed Nails, to the Number of twenty Pair on each Side towards the Head, for the Space of an Inch.—After this they are placed singly on each Side quite up to the Head.—The Worm not only inhabits the *Earth*, but feeds upon *Earth alone*, which no other Animal does that we know of.—If a dead and dry Worm be split along with a Penknife, you see the Body filled with *real dry Earth*, no way different from Garden Mould.—All these particulars you will more satisfactorily view in Specimens of each, included in Glass Tubes, for the Employment of some of your leisure Minutes.

T H E

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART II.
CONTAINING
A General SURVEY of BIRDS.

DIALOGUE I.

*Of the NATURE of BIRDS in General; Of their
peculiar FORM, MOTION, WINGS for FLIGHT,
FEET, &c.*

Cleonicus.

WE are now brought, in the natural Order of our Speculations, to a Survey of the most gay, soft, and delicate Species of Animals in the Creation; and I am sure my *Euphrosyne*, will not be sorry for that.

Euphros. I presume, by what you say, that the Subject of our next Conversations will be the *Feathered Tribe*, of *Animals*.—These must afford many pleasing Reviews, indeed, *Cleonicus*.

Cleon. The Subject, at least, will be new, my *Euphrosyne*, for a Bird differs much from a *Quadrupede*, and still much more from an *Insect*; and as to a *Serpent* or *Reptile*, there is scarce any Resemblance at all in regard to their Form and Manner of Life.—A *Bird* has all the five
Senses

Senses of *Quadrupedes*—has a *Brain* and *Marrow*—has *Nerves*, *Arteries*, and *Veins*.—Muscles and *Tendons* in a remarkable and conspicuous Manner.—A *Head*, *Breast*, and *Belly*.—All the *Viscera* or Vessels receiving, and digesting, concocting and converting it into *Blood*.—All kind of *Glands* (except the *Mamillary*) for secreting the various Fluids, necessary to carry on the Animal Oeconomy.—A *Skeleton* of Bones, *Scull*, *Spine*, *Ribs*, and two *Legs* instead of four.

Euphros. I perceive from what you have said, *Cleonicus*, that the principal Difference between a Fowl and a four-footed Animal consists chiefly in the *External Parts*, as the *Beak*, the *Wings*, and the *Feathers*.

Cleon. You judge very rightly, my *Euphrosyne*; these are the *Criteria* of the Nature of Birds; with respect to the Beak or Bill, the upper Part may be considered as a Prolongation of the *Scull*, tapering and terminating in a Point, and is therefore *fixed*, in most Birds, for in some it is *moveable*, as you may observe in your favorite *Poll Parrot*, at any Time, particularly when she *yawns*, which no other Bird does.—Indeed, this peculiar Faculty in the Parrot, demonstrates that this upper Part of the Beak is not really a Part of the *Scull* which is Bone, but a hard horny Appendage fixed to the *Scull*.—And the lower Part of the Beak is evidently similar to the lower *Jaw-Bone* in *Quadrupedes*, moveable as in them, but tapering to a Point.—So that considering the Head and Beak of a Bird together, they constitute that Form of the whole, which is best of all adapted to pierce, divide and move through the resisting Medium of Air.

Euphros. Wonderful, indeed; this alone demonstrates design in the original Formation of this Genus of Animals. But tell me, *Cleonicus*, are not these two oblong Holes, which I observe in the upper Part of the Beak near the Head, the *Nostrils* of the Bird?

Cleon. They are, my *Euphrosyne*; the Bill being, in some Sense, in lieu of a Nose in four footed Beasts, and Man.—They have also *Wind-Pipe*, and *Lungs* for Breathing, as in us.—And Naturalists have found, that there is a most peculiar Construction of the *Wind-Pipe* in its upper Part, as also the Muscles for moving it, as particularly
favours

favours the Voice of Birds, and contributes to perfect and modulate the fine melodious Notes of these *Aerial Songsters*.

Euphros. Songsters indeed; their Notes are Natural Music and Melody! the Evening *Nightingale* always brings Pope's Verses to my Mind.

*So when the Nightingale to Rest removes.
The Thrush may chaunt to the forsaken Groves;
But, charm'd to silence, listens while she sings,
And all the Aerial Audience clap their Wings.*

Cleon. The *Sky-Lark*, the *Linnet*, *Canary Bird*, *Nightingale*, and all the *Warbling Choir*, have been the perpetual Theme of Bards in all ages of the World.—But another thing peculiar to *Birds*, is, that they have Ears, and yet shew none, my *Euphrosyne*.—

Euphros. Indeed I see none till the Feathers are plucked off the Head, and then I observe *two Holes*, one on each Side the Head, which I suppose are Passages to the Ears you speak of; am I not right, *Cleon*?

Cleon. Very right, my *Euphrosyne*; if they had External Ears, like Quadrupedes, they would not only destroy the proper Shape of the Head, but be an impediment to their Flying also.—We find, that notwithstanding this, Birds have this Sense in as exquisite a Degree, as any Sort of Animals whatever.—Hence, as well as in *Insects*, we see Omnipotence is not confined to one particular Method of producing the same Effects of Sensation.

Euphros. I observe in the Bills, or Mouths of all Birds there is a *Tongue* proportioned to their Size, as in Beasts, and consequently they have the Sense of *Taste*, but to what Purpose, *Cleon*, since most Birds feed upon Grain, and swallow it whole?

Cleon. In Birds of *Prey*, as the *Eagle*, *Vulture*, *Kite*, *Hawk*, &c. (called carnivorous Birds) the Tongue is undoubtedly the Organ of *Taste*, as in us.—Also in those that feed on *Maggots*, *Insects*, &c. as most of the *Granivorous* Sort do at Times.—For this Purpose you see their Tongue is hard, bony, and bearded at the End to stab, and take up small Worms, Insects, &c. A wonderful instance

stance of this, you have in the *Wood-pecker*, *Snipe*, *Wood-cock* &c.

Euphros. Do you not account it another *Singularity* in *Birds*, that many of them can so compleatly imitate the *Human Voice*, as to pronounce some *Words*, and even *Sentences*, as distinctly as we ourselves can do?

Cleon. Verily it is, my *Euphrosyne*; in this Respect, they come nearer to us than the *Jackanapes* itself, for he can only *grin* and *cackle* at most.—Indeed it is a Matter of great *Curiosity* and *Surprise* to hear a Bird talk so articulately as to be mistaken for a London Cry.—’Tis absolutely Fact, and I can just remember it, there was a Parrot at a Butcher’s Shop in *St. Martin’s-Court*, who had learned to Cry—*The last dying Speech and Confession, of the four Malefactors, who were executed this Morning at Tyburn*, so often repeated by the Hawkers in that great Thoroughfare, that Strangers were often observed to look about them, thinking it was Hawkers they heard.—And, indeed Sister, I was told your pretty pretty Poll could *swear in Spanish*, as well as the best Sailor in the Ship that brought her over; nay, and lie too, for she would call every Man she saw come to the House a *Cuckold*, till she was taught better Manners.

Euphros. Why you give a woeful Tale of my poor Poll, *Cleonicus*; but I can assure you she is grown much more polite and decent in her Language, since she has learnt English, and improved in her *Pronunciation*.

Cleon. Besides *Parrots*, who are the principal Speakers among Birds, there is the *chattering Pye*, or *Magpie*, the *Quail*, the *Bull-finch*, and even the *Robin-red-Breast*, as I have heard say.—As to the *Eyes* of Birds, they differ from those of *Quadrupedes* in so few Particulars, except the Size, that we have nothing new to speculate there.

Euphros. I think the most considerable Difference between a Fowl and a *Quadrupede* is the *WINGS*, after all, *Cleonicus*.

Cleon. It is evident from a Consideration of the internal Structure of both, that the Wings of a Fowl are so very analogous to the fore Feet of Beasts, that they consist, three Parts out of four of the same Bones; for Instance, they have the *Shoulder-Bone*, the *Collar-Bone*, the single Bone
of

of the first Joint, the two Bones of the second.—But the other Bones, which make the *Hands* in us, and the *fore-Foot* in Beasts, are in Birds, in a peculiar Manner fashioned for the Insertion of the larger and strong Feathers, which properly form the WING.—Indeed, all the Bones have a particular Conformation for that Purpose; and their *Articulations* by Cartilages, Ligaments, &c. are so extremely strong and firm, that you find it no easy Matter to separate the Wings and Legs from the Body of a Fowl, notwithstanding all your dexterity in that Affair, my *Euphrosyne*.

Euphros. Indeed. *Cleonicus*, I have no great Skill in Carving; the *Etiquette* of the Table, has never been my principal Study.—I have much greater Pleasure in hearing a Philosophical Lecture upon Fowls, than in dining upon one.—But now we are upon that Subject, give me leave to tell you, that I have often admired the particular Form and Shape of the *Breast-bone* of a Fowl; I suppose this, too, conspires with the rest, to give a proper Figure to the Body for *Flight*.

Cleon. You have again exactly hit it off, my *Euphrosyne*; the *Breast-bone* of a Bird is nearly the Figure of a Boat with a Keel; both formed with the same View, to divide and move through the resisting Mediums of *Air* and *Water* more easily; the Motion of one is produced by *Wings*, of the other by *Oars*, acting upon the same by repeated Impulses.

Euphros. I observe, *Cleonicus*, a *Bird* or *Fowl* has more Modes of Motion than most other Animals; for they can fly, walk, hop, and run, very fast; and some of them swim.

Cleon. Scarce any one Bird has all these Motions, my *Euphrosyne*; the *Ostrich*, for Instance, is so large and heavy, that he cannot fly, though his Wings assist him greatly in running very fast.—Again, *Swans*, *Geese*, *Turkies*, *Peacocks*, and all sorts of domestic Fowls, fly but little, but walk and run.—Lastly, *small Birds* in general, can fly and hop.

Euphros. I further observe, *Cleonicus*, that the feathered Tribe are divided into two Sorts, *Land and Water Fowl*, accordingly as they get their Living in those two Elements.

Cleon.

Cleon. But according to that Rule, my *Euphrosyne*, you might nearly as well reckon a third Sort, of *Aerial Fowls*, for all the Families of *Swallows*, *Martins*, *Swifts*, &c. live by catching their Food as they fly in the Air.—And there is a great Difference among the *Water Fowl*, for *Ducks* and *Geese* are not to be considered as *Water Fowl*, so properly as *Sea Fowl*, and others which live entirely upon *Fish*.

Euphros. According to their different Natures, I see the Feet of Birds have a correspondent Form; also several other Parts of the Body, as their *Necks*, *Beaks*, &c. How plainly do they all demonstrate Contrivance and Design.

Cleon. The Feet of Birds are well adapted to their respective ways of Life, with two, three, or four Claws; and these with strong *sharp Talons* and *Nails*.—In most Birds, the Toes or Claws are four, three standing forwards, and one backwards.—In some there are two forwards, and two backwards.—In the *Ostrich* there are only two to each Foot, and they are both placed forward, but then they have a hard Part behind, somewhat like a *Heel*, by which they stand firmly, and strike with a great Force.—Again, the *Water Fowl* have their Feet *palmated*, or the Toes connected, either wholly or in *Part*, by a Membrane to serve them in the Nature of *Oars* for *Swimming*, *Diving*, &c. But of these Peculiarities more at another Time, my *Euphrosyne*.

DIALOGUE II.

Of the PLUMAGE of BIRDS; Of the MAKE and DISPOSITION of the FEATHERS in regard to FLIGHT and CLOATHING.

Cleonicus.

WE will now proceed to further Particularities concerning Birds, my *Euphrosyne*, if you are so disposed,

Euphros.

Euphros. I have always regarded a *Bird*, as one of the greatest delicacies in Nature, the Pride of Animal Creation.—How coarse is the Cloathing of all the Quadrupedes, from the *bristly Boar* to the *finest furred Ermine*, in comparison of that of a Bird, *Cleonicus*? Pray, therefore, go on to recount to me the Wonders observable in the *Plumage* of Fowls, and the matchless Wisdom and Power displayed in the Formation of a single Feather only.

Cleon. I will do the best I can, for the Information of my *Euphrosyne*, but I assure you Sister, there is not an Object in Nature abounding with greater difficulties to puzzle the most expert *Connoisseur*, than does the Feather, trifling and common as it may appear.—However, the *Rationale* or Use of a Bird's Wing can never be well understood, till the curious Mechanism, Parts, and their Positions in the *Feathers*, are first considered and explained; and in this Affair we must be assisted chiefly by the *Microscope*.

Euphros. I am glad to hear you say that, *Cleonicus*; because when I see the Manner in which any thing is made or formed, I must think myself dull indeed not to have some Idea of it; therefore pray proceed.—

Cleon. You will know then, my *Euphrosyne*, a Feather consists of three large visible Parts;—the first is the large, hollow, transparent, horny *Pipe*, or *Quill*, by which it is inserted into the Body of the Fowl.—The second Part is the *Rib*, which is only the Quill continued under a Form and filled with a *White Vesicular Substance*, giving great Strength and Stability to the Feather—and thirdly, the *Plumage* on each Side the *Rib* of the Feather.—If the first Part or Quill you will have little Help from the Microscope, because in horny Substances you scarcely see any thing of the Texture, by reason of the Transparency of the Parts.—But in the second and third Parts you will see plainly enough of what they consist, how they are formed, and the Divine Artifice by which the whole is compacted into the most proper Instrument, for the Cloathing, Flight, &c. of Birds.—And first, here View the *Pith of the Rib*, in a thin Slice thereof.

Euphros. I do; I see it consists of very small Vesicles or Bladders nearly of a round Form, which, though *pellucid*

lucid in so thin a Slice, yet when seen by the Eye, it is opaque, though White; and even then seen by reflected Light, it shews those Vesicles very plainly.

Cleon. From this Experiment, my *Euphrosyne*, you learn the Reason of the *lightness of a Feather*, and of the Strength of it at the same Time; two essential Qualities of Feathers which compose the Wings of Fowls for Flight. But this is not all, my *Euphrosyne*, the Wings striking the Air in *Flying* are to be considered, in a Manner, as *Air-Tight*, that is, as *loosing no Air*, or having no Passage for Air through the Surface of the Wing.—This nothing but Omnipotence could effect by the Plumage of a Feather.—This wondrous Artifice is therefore next to be considered.—

Euphros. I suppose, *Cleonicus*, by *Plumage* you mean all that grows on each Side of the Rib of a Feather.

Cleon. I do, my *Euphrosyne*; this makes the Body of the Feather.—In different Feathers, this Plumage consists of such Parts as are called *Vanes* and *Plumulae* or small Feathers, which latter constitute generally, all the *Body Feathers*, and are designed for *Cloathing* and keeping the Body of the Bird *warm*.—But the *Vanes* make the Plumage of the larger Feathers of the Wings, designed (and thereby better fitted) for *Flight*.—They are somewhat convex on the outside, and concave within, and being thus placed one upon another, and so nicely connected on each Side the Rib, they make a most fit and effectual Instrument for striking the Air, and wafting the Bird along in it.—In the Wing of a Goose, you will find ten of these large Feathers of different Sizes.—The Plumage on the outside of these Feathers is narrow; on the inside, it is three or four times as wide.—The narrow Plumage consists almost entirely of *Vanes* or Parts, composed of two transparent horny Membranes, between which, for the greatest part is a thin Vesicular Substance, which appears better through the Microscope than I can describe them—therefore have placed one there for your View.

Euphros. I see it perfectly well, *Cleonicus*.—I see those Vesicles, which, as they are thicker or thinner make the *Vane* more or less transparent in the Middle, and variegate the
the

the View of it.—On one Side the Vane, I see none of these Vesicles, so that it appears perfectly pellucid and sharp like the Edge of a Knife; as also just at the End.—I observe also the Traces of some what like Blood-Vessels through the wider Part of the Vanes.—

Cleon. I find you miss no one Particular worth Notice, *Euphrosyne*; but take a View of the Plumage on the other Side of the Feather, and you find it consists of such Parts as are *Vanes* towards the Beginning, but *Plumules* afterwards to the End; so that each large Feather consists of *Vanes* on one Side, and *Plumules* on the other.—But for a more perfect Idea of a *Plumule* or small Feather, you must again apply your Eye to the Microscope, where I have cut one into several small Pieces, and laid them on a Glass for your View.

Euphros. Oh, I see them very finely.—I observe the Part by which they grow to the Feather almost wholly a *Vane*—the next Part to it, begins to be a little *plumulary*—the next to that, and all the rest to the End, appear a perfect *Plumule*.—So that from these Views, *Cleonicus*, I am enabled in some Measure, to form a tollerable good Idea of a Feather.

Cleon. You will compleat that Idea, my *Euphrosyne*, by only further contemplating the curious Manner in which all these Vanes and Plumules are connected and disposed among themselves.—You will see then how every Part of the Feather must have a great and full Force in striking the Air, and that no Air can naturally pass through the Plumage of the Feather; and in the expansion of the Wing in Flying, the narrow Plumage of one Feather lies over the broad Plume of the other next to it, and so on throughout the expanded Wing, you will easily see the Reason why the whole Surface of the Wing must have so great a Force to strike the Air, and consequently, by which it receives so great an Impulse from it, as often to maintain a long and tedious Flight.

Euphros. Well, I think you have let me into the Mystery and rationale of *Flying*, and of course, of the Use of the *Wings*, to a pretty good Degree, *Cleonicus*; but next to *Wings* there is another Part in the Plumage of Birds, I

mean the *Tail*, which I suppose is of the last Importance in Flying.

Cleon. Indeed it is, my *Euphrosyne*; and as the Feathers of the *Tail* have a large and nearly equal Plumage on each Side the Rib, so they are spread out like your Fan into a Position, that contributes to render the Bird more boyant, and to regulate its Motion in turning this Way and that; in *ascending* higher, or *descending* lower in the Air; in short, to Ballance the Bird in every Mode of Flying.— This Tail is moveable in every Bird, which makes it of still greater Use in Flight; and adds great Beauty and Air to it in Walking, and on its *Pearch*.—

Euphros. As Birds in general are exposed to all the Inclemencies of the Atmosphere, it being their proper Element, and particularly great Degrees of Cold in the upper Regions, and in severe Seasons, I find *Cleonicus*, Nature, ever provident and beneficent, has wonderfully provided for them in this respect, by a very thick, warm, and comfortable Clothing of Plumage, over all Parts of the Body that need it.—I often reflect on this Provision of Providence when I see a Fowl plucked for Dressing.

Cleon. And well enough you may, my *Euphrosyne*, when you see to what a Quantity they amount, even in a Chicken; and especially in the larger Fowls, as *Geese*, and *Turkies*.—And here we cannot but admire how fitly every Thing is contrived to answer the Purpose of Clothing.—All the *Body-Feathers* are plumed for the most Part, and equally so on both Sides of the Rib; but in the Parts next the Body, they are furnished with a fine *Down*, all around; and a little above the Quill, the very Plumules on each Side the Feather, terminates in *Down*—but what is further amazing, is, that upon the Quill of these Feathers you observe a very small or secondary Feather grow out, which by its fine Plumage or Down, covers all the Interstices of the Plumules of the larger Feather next the Body, so that if there were nothing more, it should seem impossible for the Air to penetrate through such thick and double Plumage to affect the Body in any sensible Degree.—But Infinite Wisdom did not judge all that was yet done, sufficient, without an universal *Covering of Down* between the Feathers, growing immediately

ately out of the Body of the Fowl itself ; by this Means all Access of Air is entirely precluded, and any Injuries therefrom prevented.

Euphros. The whole Affair of *Clothing Birds*, is truly astonishing, from Beginning to End.—But pray, *Cleonicus*, what is this *Down* upon the Body of Fowls and their Feathers? It is so nice, so fine, so delicate and light a Matter, that I can make but little of it, by barely viewing it with the naked Eye.

Cleon. I don't wonder at that, my *Euphrosyne* ; it is a *Microscopic Object*, and none of the least entertaining.—I have endeavoured to give an Idea of a Feather at large, but now you must view a Feather of a *Microscopic Size*, and *Form* ; for such is every separate or single Piece of Down.—I have properly displayed one upon this Glass, and will place it under a deep Magnifier for your View—there, behold it.—

Euphros. I do ; and indeed, *Cleonicus*, it is a most unusual and wonderful Phænomenon.—I know not what to compare it to ; it seems like a Tree of Feathers growing innumerable from its Head.—The Body of the Tree is a perfect Quill, and its Branches are all Plumules, twelve or fourteen Times as long as the Shaft.—But these Plumules consist not of other Plumules, like those of a large Feather, but rather of something like Bristles or Hairs—I should be glad to have a View of one of those Plumules singly, through a still deeper Magnifier.

Cleon. I supposed your Curiosity would lead you to that, my *Euphrosyne* ; and I have therefore provided a single one for that Purpose—look at it.—

Euphros. I see it now to my Satisfaction, *Cleonicus* ; what composes this Plumule, I observe, are long round small Bodies on each Side the Rib, which proceed tapering to a Point—but their Surfaces far from even or polished—they appear *knotted* in several Parts at a Distance through their Length.—Yea further, they are *bearded* or barbed, I see, just like the long Hairs of the Caterpillar you shewed me some Time ago.—In short, I find the whole design of this *Downy Plumage* is to make a thick, light, and close COVERING for the Body of the Bird, whose Parts are all so interwoven, and cling so fast to

each other, that nothing from the external Air, or the Appulse of other Bodies, can derange or hurt them.

Cleon. I presume by this Time, my *Euphrosyne* has acquired a pretty good Notion of the Nature and Use of the Plumage of Fowls, there remains only one Observation or two more to compleat it.—Nature has provided, with an *Oil-Bag*, every Fowl that flies; has placed it in the Part called the *Rump*; and has endued the Bird with an Instinct to apply its Bill to this Bag to squeeze out Oil when necessary, for *Preening* and *Dressing* their Feathers; and this is a Business they are always attentive to, and very dextrous in performing.—No Fluid, but *Oil*, will answer this Purpose.—Water sticks to few Feathers but those of *Poultry*, which are seldom exposed to *Rainy Weather*, and never go into *Water*.—You may put the Feather of a Duck or Goose under Water, and it will come out as dry as it went in.—In short, you see a Feather contains in it's self a great deal of *Oil*, by the common Experiment of burning it.

Euphros. Surely a Feather is a momentous Thing! absolutely necessary to *Birds*, and almost so to *ourselves*.—For who, *Cleonicus*, can shift without *QUILLS* to make *PENS*? And who would not think his Lot in Life very hard, if he had not a *soft Feather-Bed* to lie on?—How does the *Ostrich*, *Maccaw*, *Parroquet*, &c. contribute to the Grandeur and Pomp of Human Dress, and the *Nodding Plume* of *Kings* and *Heroes*, has always been reckoned among the most conspicuous and sumptuous Ensigns of State, by Poetical Writers.—Thus Homer describes the *Helmet* of *PALLAS*,

*The massy Golden Helm she next assumes,
That dreadful Nods with four o'er shading Plumes.*

Cleon. To the many Uses you have mentioned of the Plumage of Birds to Mankind, you may add one more, my *Euphrosyne*; which is, that instead of the close and heavy common Bed-Cloaths, a *Covering* made of *Edder-Down*, is infinitely more convenient and healthy, as has been long experienced by *Invalids*, and particularly *Gouty* People.—This Bird called the *Edder*, is common
in

in the *Northern Climes of Europe*, and Nature has indulged her with an uncommonly fine Down on her Breast, which she plucks off to make a soft warm Bed for her young Ones.—It is a Sort of *Wild-Duck*, whose unparalleled soft Down, is of late become a most valuable Article of Trade; but this Sort of Bed-Furniture is as yet very dear.

DIALOGUE III.

On BIRDS of the largest Size, the OSTRICH, CASSOWARY, BUSTARD, &c. Of the least Size, the HUMMING-BIRD. Of BIRDS of PREY, the EAGLE, VULTURE, FALCON, BUZZARD, KITE, HAWK, &c.

Cleonicus.

OUR last Conversation, my *Euphrosyne*, turned chiefly upon the admirable Construction of the Wings of Birds for *Flight*; but there seems something more yet wanting to explain all the *Phænomena of Flying*.—A (*Je ne scai quoi*) secret powerful Energy in Birds to move through a great Space in the Air without any Apparent Motion of the Wings, by way of striking the Air to convey themselves through it.—This is very observable in all *Swallows*, *Swifts*, &c. also in *Kites*, *Hawkes*, &c. And this Mode of Flying is called the *Skimming of a Bird* through the Air.

Euphros. I have observed it in *Swallows* very often, *Cleonicus*; I have seen them Skim along through the Air, or aloft in the Azure Sky, with a swift Motion, up and down, this Way and that, without the least Stroke with the Wing for a great Way together.—I dare say a *Sparrow* in flying that Space would have struck the Air with his Wings a hundred Times at least.

Cleon. This Motion of Birds is analogous to that of Spiders nearly, who, as I formerly observed, can move

every Way through the Air, without any Wings at all; and the *Wing* of a Bird, without actually striking the Air, will no more account for so rapid a Progression through it, than the *Web* of the Spider will for his *secret Art of Flying*.—But after all our Efforts, my *Euphrosyne*, we must be content to *know but in Part*, and to admire the Rest.

Euphros. I always rejoice when I see the Reason and Cause of a Thing—and humbly submit when I cannot, with silent Wonder and Adoration of the Author.—But as there are many Things relative to Birds, that will at least afford Us a delightful Speculation and Amusement, let us next, *Cleonicus*, apply to some of them.—I doubt not but you have something worthy Notice in Regard to the *Size of Birds*.

Cleon. This is a very striking Topic, my *Euphrosyne*; it is wonderful to consider the Difference there is between the two Extremes of Magnitude in the *Ostrich* and the *Humming-Bird*.—The *Ostrich* measures six Feet, from the End of the Bill to the Rump—the Head and Neck, three Feet—therefore the Body is also three Feet long—from the Back to the Feet, four Feet.—The *largest Feathers* are at the Extremities of the Wings, and Tail, and are generally *white*.—The Plumage of the Body, where found, is commonly *black and white*—but on the Sides, Thighs, and under the Wings, there is none.—The upper Part of the Neck and Head is covered with Hair.—A smooth or wrinkled Skin covers other Parts.—And a Sort of Scaly hard Skin covers the Legs and Claws.—This wonderful Bird is found in great plenty in the Deserts of *Africa, Asia* and *America*.

Euphros. Though I have never seen an *Ostrich*, yet I am well acquainted with the curious and noble Form of its Feathers.—But they seem more designed for grandeur, than for Flight.—And though these are the largest and most flowing Feathers of all, yet they are only a *larger Sort of Down*, for they have exactly the Form of the Downy Feather you shewed me in the Microscope,—well now for the other Extreme, or Bird in *Miniature*, the *Humming-Bird*, *Cleonicus*, if you please.

Cleon.

Cleon. This Bird is as remarkable as the other, being barely an *Inch* long; so that forty-six thousand *Humming-Birds* are not equal to one *Ostrich*.—It is certainly the smallest Bird yet known—it sucks out the Honey of Flowers with it's small, but long and slender Tongue.—It also catches Flies and small Insects.—The Motion of it's Wings is so swift, as hardly to be perceived, which makes a constant Humming Noise in the Air (like what you observe in the *Humble Bee*) and from thence it has its Name.—I cannot shew you one alive, my *Euphrosyne*, but here is a *dead One* which I have reserved on purpose, for a Present to your little *Museum*.

Euphros. *Cleonicus*, you are very obliging—what a dear little Animal it is!—It is the Picture of a *Sparrow*, or rather a *Sparrow-Hawk* seen through a *Concave Lens*.—I admire it much for its neatness and smallness, and shall preserve it as a great Curiosity indeed.

Cleon. You will think it a Curiosity by and by, my *Euphrosyne*, when I have told you all.—Natures gaiety and *Pride of Colouring* is no where so profusely displayed as in Birds;—and there is no Bird which shews so little Decoration as the *Humming-Bird*, and who yet can boast of it in so ardent a Degree.—

Euphros. I scarcely know what you mean, *Cleonicus*; I see no Colour at all, but a common Brown—and what you mean by an ardent Degree of Colouring, I confess I am at a Loss to guess.—

Cleon. Why then my *Euphrosyne* shall see what I mean by looking through this small Hole in the Side of the Band-box.—There it is, apply your Eye to it.

Euphros. I do, *Cleonicus*; but what do I see?—Something that looks of a fiery Colour, if I may so call it—it has no likeness to any of the Colours of the *Prism* or *Rainbow*—It has more the Appearance of a glowing Coat, than any Thing else I can think of.—By what you said, I should have thought this glowing Colour had been in the little Bird, but I see no Sign of the Bird any where.

Cleon. I believe so too, my *Euphrosyne*, for I have concealed the Bird from your View, by placing it in a small Tube, in which I have cut an oblong Hole to shew the Feathers of the Neck, and part of the Head; and then

placing every Thing in a requisite Position, those Feathers reflect the Light in the wonderful Manner you have seen.—But now I take the Bird out of the Case, you view it in the usual Manner, and see no Colour in it.—

Euphros. Well, *Cleonicus*, this is a paradoxical little Creature.—No Colour viewed one Way—but all in a *Flame*, if viewed in another.

Cleon. I believe the like Phænomenon is not any where else to be found.—But now, my *Euphrosyne*, we shall again return to the Speculation of the larger Sort of Birds which have *Wings*, and yet cannot fly.

Euphros. What other Bird besides the *Ostrich*, do you find of that Sort, *Cleonicus*?

Cleon. But one more, my *Euphrosyne*; and that is the *CASSOWARY*, a Bird nearly the Size of the *Ostrich*, but its *Wings* considerably less; therefore it is no wonder it cannot fly.—It has three *TOES* or *Claws* on each Foot, all placed forwards, with a *Callosity* behind to serve for a *Heel*.—It is decorated with a hard, horny, party-coloured *Crest* on its Head, and naked *Wattles* below.—Its Covering can hardly be called *Plumage*; at least, it is of a most singular Kind—for though there be a *Quill*, it is not much bigger or longer than that of a Sparrow.—From the *Quill* proceed two very peculiar Feathers, with a Sort of *Plumage* as odd; for the Rib of the Feather is about twelve or fifteen Inches long—is of a High Polish, and bigger than a large Horse-Hair.—The *Plumulae* on each Side about an Inch long, and of the same Colour and polished Substance; so that the Bird seems covered with *Hair* rather than *Feathers*.—These Kind of Feathers are very thick and long in the Tail; but their *Wings* scarce appear from under them.—The *Wings* assist much in running swiftly, for what is said of the *Ostrich*, is true of the *Cassowary*.

*What Time she skims along the Field with Speed,
.. She scorns the Rider, and pursuing Steed.*

Euphros. We generally observe in every Part of Nature's Workmanship, if any Thing be deficient in any one Respect, it is generally compensated in some other.—But
what

what other large Birds of this Sort do you find *Cleonicus*?

Cleon. The BUSTARD, is I believe, the next largest Bird, though it be not too heavy to fly, yet it flies with difficulty, and very seldom.—Its Neck and Head is about a Foot long—its Legs and Thighs about a Foot and a Half—and its Body about two Feet long.—It has only three Claws forward; and instead of a Claw behind, there is a hard callous Substance for treading and standing more firmly.—They are found in most Parts of *Europe*, and in many large *Heaths*, *Plains*, and *Downs*, in *England*.—This Bird is of Note on two Accounts.—First, as the *First Bird of Flight*—and secondly, that it is esteemed very high Eating by the Nobility; but I fancy my *Euphrosyne*, as well as *myself*, would rather chuse to dine on a *Turkey* or *Goose*, though a vulgar Dish.

Euphros. Yes, *Cleonicus*; and a Dozen of *Sparrows* exceeds them all.—I suppose the large Birds you have mentioned, stand first in Point of Magnitude.—Pray *Cleonicus* what is the next remarkable Class of Birds?

Cleon. Birds of PREY, my *Euphrosyne*; the Principal of which are the *Eagle*, the *Vulture*, the *Kite*, and the *Hawk*.

Euphros. You are now come a little within my Sphere of Knowledge, *Cleonicus*.—I know the *Kite* and the *Hawk* too well,—and I well remember the *Eagle* we saw, but a few Months since, when we dined with Farmer *Sturt*, that was nailed against the Gable End of his House, with his Head, Wings, and Legs expanded, which one of his Servants had lately shot.—His House being near a large *Wood*, they were but too often visited by all these Birds of Prey, the *Vulture* only excepted.—I well remember the fearful Form of the *Eagle's* Bill—the strong make and great Extent of his Wings—but above all, his large boned *Legs*, and unmerciful CLAWS and TALONS, the very Sight of which made me shudder.

Cleon. I was much rejoiced my *Euphrosyne* had an Opportunity of so good a View of the *King of Birds*.—This is a Bird of the greatest Celebrity not only among [Naturalists but Poets too.—What a fine Description of an *Eagle's* seizing upon a *Serpent* is that in *Virgil*!

So

*So when the Imperial Eagle soars on high,
And bears some speckled Serpent through the Sky;
While her Sharp Talons gripe the bleeding Prey,
In many a Fold, his circling Volumes play.
His starting brazen Scales with Horror rise,
The sanguine Flames flash dreadful from his Eyes,
He writhes and hisses at his Foe in vain,
Who wings at Ease the wide Aerial Plain,
With her strong hooky Beak the Captive plies,
And bears the struggling Prey triumphant thro' the Skies.*

Euphros. When the Eagle is viewed alive and on his Perch, he must certainly appear a superb and majestic Bird.—It is no wonder he has been held in a Sort of religious Veneration, and esteemed the *Bird of Jove*, the Sovereign of all the Gods.—But pray, *Cleonicus*, what Sort of Animals or Game does he prey upon?

Cleon. The young of any Animals in general, and the old ones too, when not too large to bear away in his Talons; but particularly Birds and Fowl of all Sorts which the Woods and Forrest produce.—But it is said, that he is so nice in his Diet, as never to touch a Bit of *Carrion*, but feast himself wholly on the Prey which he kills and dresses himself; whereas no other Bird is so *fine mouthed*, my *Euphrosyne*.

Eupros. What Bird of Prey do you reckon next to the Eagle, *Cleonicus*?

Cleon. The *VULTURE* is certainly second to the Eagle, and about as big; but it has not so elegant and noble a Form and Presence, though it commands great Regard from all who see him; as he really is a grand, noble, and stately looking Bird.—The Bill or Beak of the Vulture is strait for about two Inches, and then turns down in a strong sharp Hook on the upper Part, whereas in the Eagle the Bill is wholly curved to the End where it is very hooked.—Another Thing in which the Vulture differs from the Eagle, is, that the Legs are feathered quite down to the Claws, but in the Eagle they are covered with a Sort of *scaly Skin*, which they cast off at times.—The *Vulture* is a very rapacious and voracious Bird, his Appetite not in the least degree squeamish—he rather seems
noted

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noted for being fond of Carrion, and of human Flesh; this *Homer* observed in the very Beginning of his *Iliad*, as you find in the following Lines.—

*The Wrath of Peleus' Son, the direful Spring
Of all the Grecian Woes, O Goddess sing;
That wrath which hurl'd to Pluto's gloomy Reign,
The Souls of mighty Chiefs untimely slain:
Whose Limbs, unburied, on the naked Shore,
Devouring Dogs and hungry VULTURES tore.*

Euphros. I suppose these Birds admit of great Variety in their several Species, with respect to their Size, Plumage, Colours, &c. as we see in every Thing else, *Cleonicus*.

Cleon. I grant it, my *Euphrosyne*, and there would be no End in describing all—it must suffice at present to say, that the largest and finest coloured Birds of this Kind, are those called the *Golden Eagle*, and the *Golden Vulture*, as the extreme Parts of most of their Feathers are of a high red shining Colour, and render those Birds as beautiful as they are Majestic.

Euphros. Well, *Cleonicus*, after the *Vulture*, which is the next remarkable Bird of Prey?

Cleon. The *OSPREY* has been reckoned as such by some Naturalists, but others think it to be only a different Sort of Eagle.—In short, it is so rare a Bird, and so little known here, that nothing certain can be said of it.—Therefore the next Species of Birds of Prey are of the *HAWK* denomination; and these, as you observed, are but too common and well known to every *Farmer* as well as *Fowlers*.—The most considerable of the *Hawk-Species*, are *Falcons*, *Buzzards*, *Kites*, and *Hawks* of many different Sorts.

Euphros. The *FALCON* is a Bird I have no Knowledge of, but have heard much said of him; and that there are Men who make it their Business to tame them, and to train them up to fly at small Game or Fowl, and to bring it in his *Talons* to the *Falconer's* Hand.—And that this Art of *Falconry* was much in Use formerly, though very little now.

Cleon.

Cleon. In all this you have been rightly informed, my *Euphrosyne*.—And if you know what the Form of a common *Kite* or *Hawk* is, you may be assured that of the *Falcon* is much the same.—He is about the Size of a *Raven*; and the *Buzzard*, the *Kite*, the *Goshawk*, the *Sparrow-Hawk*, and others are of all sizes between the *Raven* and the *Black-Bird*.—The *Kite* is always known by its *forked Tail*, which the *Buzzard* and *Hawk* have not;—some of these *forked-Tailed Kites* are very finely coloured, and as beautiful as they are mischievous.

Euphros. One thing, not a little odd, *Cleonice*, I have almost always observed, and that is, that, whenever the *Kite* makes her Appearance she is attended with a numerous Train of small Birds, which fly after and round about her at a Distance, with continual *Screaming*, *Screeching*, *Squeaking* and *Crying*, as if they knew her to be their mortal Enemy, and thereby shewed their Abhorrence and detestation of her.

Cleon. You judge very right, my *Euphrosyne*, for that is the very Case, and so troublesome and clamorous are they when they observe the Enemy going off with it's Prey, that they will sometimes cause even an *Eagle* to drop it, and fly away to avoid them, as is elegantly described by VIRGIL.

—In the fiery Tracts above
Appears in Pomp the imperial Bird of Jove:
A Plump of Fowl he spies that skim the Lakes
And o'er their Heads his sounding Pinions shakes,
Then stooping on the fairest of the Train
In his strong Tolons trust'd a Silver Swan;
But while he lags and labours in his Flight,
And seems to scorn the base unequal Fight;
Behold the indignant Birds return anew,
And with united Force the Foe pursue;
Clam'rous around the Royal Hawk they fly,
And thick'ning in a Cloud, o'ershade the Sky;
They cuff, they scratch, they cross his airy Course;
Nor can the incumber'd Bird sustain their Force;
But vex'd, not vanquish'd, drops the pond'rous Prey,
And lighten'd of his Burthen, wings his Way.

Not

Not only Birds, my *Euphrosyne*, but all other Animals very well know their common Enemy, and never fail to pursue them with Indignation and Vengeance.—Even among Insects you may observe this.—There is what they call a *Hunting-Spider*, that takes his Prey, not by a *Web* as others do, but by running this Way and that, over the Surface of Boards, Walls, Leaves, &c. in search of Flies, which when he spies, he flyly jumps upon, and seizes them; but while he is feasting upon the poor Victim, the other flies seldom fail to worry him, and often to strike him with so much Force as to make him drop his Prey, and run off.—But this is by Way of *Episode*—so for the present Adieu.

DIALOGUE IV.

*Of the PEACOCK, the TURKEY, the PHEASANT;
the RAVEN, CROWS, ROOKS, &c. Of MAC-
CAWS, PARROKEETS, COCKATOO, and BIRD of
PARADISE.*

Cleonicus.

LET us now, my *Euphrosyne*, change the Scenes from *Birds of Prey* to those of a more innocent and agreeable Description.—And here we shall prologue our present Speculations with that Bird, which may deservedly be called the *Pride of Nature*; at least, it is most certainly the *Proudest Bird*, and that with very good Reason:

Euphros. By all this, *Cleonicus*, I cannot but suppose you mean the PEACOCK.—For that Bird must be proud, who views himself so eminently distinguished by a *Circling Glory of Colours* above all others of the feathered Race.

Cleon. We often make it a Question, in regard to most other Animals, if they are sensible of their peculiar Beauties, or set any Value upon them.—But the PEACOCK, is quite out of the Question, no one has seen him walk with his Tail expanded to the Sun, in the most majestic
and

and superb Manner, turning his lofty Head on this Side and that, beholding his splendid Plumes, but must be immediately convinced of his being sensible and conscious of his singular Beauty and Finery, and very desirous of shewing it to every curious Visitor.—But hear the Poet on this Subject.

*How rich the Peacock! what bright Glories run
From Plume to Plume, and vary in the Sun!
He proudly spreads them to the Golden Ray,
Gives all his Colours, and adorns the Day!
With conscious State the spacious Round displays,
And slowly moves amid the waving Blaze.*

Euphros. All that you and the Poet have said, I see verified almost every Time I have the Pleasure of paying a Visit to *Madame de Blanc*, who is very fond of this showy Bird, and keeps a Number of them, both Cocks and Hens.—She has obliged me with some Feathers of the most extensive Length, and largest Eyes, with which you see I decorate my *Bureau* not a little.

Cleon. A Peacock bears the first Rank among domestic Fowls, as the *Eagle* does amongst Birds of Prey, and as the *Eagle* was sacred to *Jupiter*, so was the Peacock to *Juno*, among the Ancients.—The *Iris* of a Peacock's Tail is more than a *Semi-circle*, and therefore greater than you can ever observe the various coloured Bow in the Heavens.—The curious upright *Crest* or *Tuft* of somewhat like Plumes, on the Top of the Head adds Dignity and Stateliness to the Bird.—It is said the Feathers of the Tail come to Perfection in three Years, and fall off in the *Dog Days*.—Also that this Bird was first brought to *England* from the Island of *Ceylon* in the *East-Indies*.

Euphros. I have heard it observed, *Cleonicus*, that though the Birds in hotter Climates exceed ours in the *Richness of Colouring*, yet Birds of colder Regions as much exceed them in the Sweetness of their Notes.—And indeed, I think there can't be a more direct Proof of this than the Peacock itself, whose very disagreeable Note does as much disgust the Ear, as the glaring Colours of his Tail regales the Eyes.—Not only his Voice, but his Legs are an Argument that Nature never intended this favorite Bird

Bird for a *complete Beauty*; since God knows they are ugly enough.

Cleon. All you have remarked, is very true, my *Euphrosyne*; but the World are to expect something more of you, than barely to recite the Beauties of a Peacock's Tail, that strikes the *vulgar Eye*.—By your dextrous Movement of the Feather, they will see that fine Succession of Colours arise, the *Green*, the *Blue*, the *Purple* and *Violet*, in the very same Part of the Eye, according to the various Inclination of the heterogeneous Rays of Light which fall thereon.—They will moreover expect to be entertained by a View, through your Microscope, of the wonderful and various-coloured Parts and Divisions in the Plumules of every such Feather.—Let me tell you, my *Euphrosyne* it may be in your Power to do a great deal of Good by introducing now and then a Philosophical Conversation at the *Tea-Table*, instead of the usual *Babil*.

Euphros. Oh, my *Cleonicus*, you must make many more Profelytes to Philosophy amongst my Sex, before I shall have an Audience to harangue on these Subjects.—And as to your own Sex I believe the generality of them had rather sit down to a Dissection of a *Roasted Turkey*, than to a Philosophical Lecture upon One in his Plumes.

Cleon. You mention the *TURKEY*, my *Euphrosyne*, very *a propos*; for it is the next Bird that succeeds to the Peacock in our Review, though there is nothing in him very extraordinary to regale a *Virtuoso's* Taste.—His Feathers are rather large than beautiful,—but he can spread out his Tail like a Fan, as the Peacock does.—There are some in *America* much finer and more decorated than ours.—And so much for the *Turkey*, till he is spitted.

Euphros. If the *Turkey* has so little of the agreeable, pray what think you of the *COCK-PHEASANT*, *Cleonicus*?

Cleon. I think it is a wonderful fine Bird, my *Euphrosyne*, the beautiful Colours about its Head, Eyes, Back, and particularly the long and delightful Tail, render it as genteel and elegant an Object as most that Nature affords of the feathered Kind.—Some that are brought from *China* and the *Indies* are exquisitely coloured and variegated with Specks, Spots, Streaks, and Lines to an amazing Degree of Delicacy and Beauty.

Euphros. Indeed the Pheasant is so fine and favourite

a Bird with me, that it is with no small Degree of Compunction I read the hard and cruel Fate it is constantly subject to from the Hand of every Fowler, in the following Lines of Mr. POPE.

*See from the Brake the whirring Pheasant springs
And mounts exulting on triumphant Wings :
Short is his Joy ; he feels the fiery Wound,
Flutters in Blood, and panting beats the Ground.
Oh ! what avail his glossy varying Dyes,
His purple Crest, and Scarlet-circled Eyes ;
The vivid Green his shining Plumes unfold,
His painted Wings, and Breast that flames with Gold ?*

Cleon. The Description is very pathetic and moving indeed—I don't wonder they affect the tender feelings of my *Euphrosyne*.—I shall take an Opportunity ere long of shewing you some of these exotic Beauties as we walk for an Airing in the Earl of W—— Gardens ; where you will gratify your Sight with various other Birds from foreign Parts, in southern Climes.—What is somewhat remarkable, is, that both Peacocks and Pheasants are sometimes found all over *White*.

Euphros. Why that, *Cleonicus*, would be as strange a Sight, as to see a *White Black-a-more* ; and yet a Girl about seven Years old, was lately shewn here, her *Mouth, Lips, Eyes, wooly curled Hair*, and every other Feature, was the same as in a Common *Black*.

Cleon. Such Deviations from the general Laws of Nature, are also observable in many other Instances, as *White Black-Birds, White Mice, &c.*—This Digression reminds me of the Merry Metamorphosis of the *Raven's* Colour in Ovid, which he feigns was *originally White* ; but for telling Tales on the Nymph *Coronis*, Apollo in a Wrath changed his Milk-White Plumes to black, or thus in Verse ;

*Then in his Fury black'd the Raven o'er,
And bid him prate in his white Plumes no more.*

Euphros.

Euphros. Now you mentioned the RAVEN, *Cleonicus*, don't you think him a comical Sort of Bird?—I have often smiled at his Sidling Hop, sentimental Leer, and droll Gestures.

Cleon. Indeed, my *Euphrosyne*, so have I too.—*Ralph* is an odd Fellow, a mere Sly-Boots, and as arrant a Thief as ever was hanged.—Mischievous is his Amusement and Study.—He will filch your Silver-Spoons, Buckles, laced Ruffles, and every Trinket he can lay his pilfering Beak on, and Hop away with them to his Holes and hiding Places, where he deposits all his stolen Goods.

Euphros. As he is naturally inclined to be wicked, pray *Cleonicus*, how came he by the Reputation of a Fortune-Teller, or a Bird of Ominous and direful Presage, from his Hoarse Notes, and boading Flights?

Cleon. For the very same Reason that any cunning crafty Knave easily acquires the Reputation of a Conjuror, Sooth-sayer, or Miracle-Monger;—that is, by the Ignorance, Credulity, and shameful Superstition of the Vulgar unthinking Part of Mankind.—If one of those *Ignoramus's* set out in the Morning for a Journey, and a Raven should chance to fly across his Way with a Quark, Quark, Quark, he stops short in a Panic, hangs down his empty Noddle, and *Raven-struck*, hies himself home again.—It is wonderful to consider how dim the Lamp of Reason burns in the greatest Part of Mankind, and how readily and easily they are duped into the Belief of any ridiculous Doctrine whatsoever by designing Impostors.—I have always thought Pope's Lines on Superstition exquisitely fine.

*She from the rending Earth, and bursting Skies,
Saw Gods descend, and Fiends infernal rise.
Here fix'd the dreadful, there the blest abodes,
Fear made her Devils, and weak Hope her Gods,
Zeal then, not Charity, became the Guide,
And Hell was built on Spite, and Heav'n on Pride.*

Euphros. Well, one Comfort is, while I learn Philosophy, I shall be in no great Danger from Superstition—therefore, pray *Cleonicus*, proceed on your Lecture.

VOL. III.

I

Cleon.

Cleon. The only Remark I have further to make on the Raven, is, that it is a Bird of the finest shining jetty Black in Nature; and that *Crows*, *Rooks*, and *Jack-Daws*, are little more than *Mullattoes* compared with him.

Euphros. I see the Proverb made good in these Birds, *that Birds of a Feather will flock together*.—So I observe *Ravens* go with *Ravens*, *Crows* with *Crows*, and *Rooks* with *Rooks*, in pursuit of their Food.

Cleon. But above all, the *Rooks* are the most sociable Birds we know, they not only *associate*, but *live together*; and what is called a *Rookery* is only a little *State* or *Commonwealth* of *Rooks*, such as you see in the *Temple Gardens*, and in the Country, about most large Farm-Houses; for the Farmer finds his Account in keeping them, as they constantly attend the Plough to pick up the *Grubs*, *Worms*, and other Reptiles, which destroy the Corn when sowed.

Euphros. If the *Rookery* be a Regular Community of Birds, I suppose they have a *proper Language* in which they converse, and is that squalling Noise which they continually make in our Ears.

Cleon. You are certainly right in your Conjecture, my *Euphrosyne*; for though it seems nothing but *Cawing* to us, yet to themselves each Note may be, and I make no Doubt but is, an *articulate Sound*, and by a various Modification and Modulation thereof, altogether insensible to us, they express their different Ideas, much after the same Manner as the *Chinese* and *Ethiopians* do by their Characters, which when seen and heard from their Mouths, are just as indistinct and unintelligible to us, as the Conversation of *Rooks*.—Nay it is certain there is less confusion of Notes and Voices in a *Rookery*, than in the human *Hum-Buz* of the Royal Exchange; and *Rooks* would think of Merchants just as we do of them, that they are a *noisy Kind of Mortals*.

Euphros. I think of nothing more material to ask about Birds of this sable Complexion, *Cleonicus*; What Birds next deserve our Notice that are of a more party-coloured and enliv'ning Aspect?

Cleon. A proper Contrast to a Crow is, I think, a *MACCAW*; if this Bird be not fine enough for you, my *Euphrosyne*, I know not where to find one that is so,—

It

It is the largest Bird of all the *Parrot Kind*, measuring three Feet from the Tip of his Bill to the End of the Tail, and the Tail itself is eighteen Inches.—The Bill is Black, and so hooked, as to make almost a Semi-circle, and is three Inches long, and two and a Half thick near the Head.—They are of many Sorts and Colours.—The finest I have heard of, has a whitish Space about the Eyes; and the whole Body, part of the Wings, and all the Tail, are of a beautiful *Red*; as also the inner Part of the Prime Feathers of the Wings—the outward Parts are of a *deep Blue*, as well as the under Part of the Tail near the Rump.—The second Row of the Quill Feathers are Yellow, with Red Edges, and as it were marked with a bluish Eye at the End.—Two Feathers in the Tail are (in some) much longer than the rest, and end in sharp bluish Points.—The Legs are short, the Feet Brown, and the Claws Black.

Euphros. I remember to have seen the gaudy Birds of this Description, as I have passed by the *Bird-Shops* in *Helbourn, Piccadilly, &c.*—The *Grey Parrot* is not very remarkable for any Thing but Loquacity, and a frightful Squall.—But I have heard much of *PARROKETS, Cleonius*, pray what Sort of Parrots are they?

Cleon. They are less than the common Parrot, being a little bigger than a *Thrush*; but some of them have very long Tails, and are in most respects coloured like *Maccaws*, with Green, Yellow, and blue Feathers in great Variety, according to the Countries which produce them; for they are brought from the Torrid Zone in every Part of the World, as all Birds of this Kind are.—You must certainly have seen these *Parrokets* in the same Shops where you saw the *Maccaws*, for they are generally imported together.

Euphros. I saw many of them, but as I did not stop to ask their Names, I knew not that they were Parrokets.—I see there is a Gradation in the Parrot Kind, from the largest Maccaw to the least Parroket.

Cleon. There is another Bird yet of the Parrot Kind, which I believe my *Euphrosyne* has not observed among other exotic Birds, as they are not so frequent here as other Parrots are.—The Name of this Bird is *COCKATOO*,

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so called from his Note which is always *Cockatoo, Cockatoo*; but this is natural, and not learned by Art, as in yours, *Pretty, Pretty Poll*.—He is a sprightly Bird, about the Size of a Raven, and has a large strong Bill, of a bluish Black.—The Head is large for the Body—with dark Eyes, and a light Ash-Coloured Circle round them.—The whole Feathers that cover the Head are very long and loose, especially those on the top of the Head, which he can raise up or let fall at pleasure.—When anger'd, he not only raises the *Crest*, but the Feathers on each Side the Head, and then their under Parts appear of a fine *Scarlet*.—The Plumage is White, tinged with other Colours in some Parts.—The Tail is short, and the Feathers of an equal Length. The Legs and Feet are of a *Red Colour*, and the Toes as in other Parrots.—There is a lesser Size, but are all East-India Birds.—If you speak to them, they Answer in the same Tone of Voice, loud or low.—

Euphros. By this Description, I shall certainly discover them when I happen to come across them.—What other fine foreign Birds are remarkable, *Cleonicus*?

Cleon. Many which at Times may be seen, my *Euphrosyne*; but amongst all, none comes up to the BIRD OF PARADISE; it being esteemed the most genteel, elegant, and beautiful Bird in the World; and is so called as if no Place but *Paradise* could produce it.—But, after all, it is no more than the most delicate of all *East-Indian* Birds.—And because you should have as compleat an Idea of so great a Rarity as possible, I have procured one for your *Museum*; and here it is in a Glass Case.—

Euphros. Well, *Cleonicus*, now you have obliged me indeed.—A wonderful Curiosity this!—Surely it is the Pride of all the plumed Creation!—What is the taudry Maccaw to the *Bird of Paradise*! The sweetness in the Form and Features of this Bird, no Rhetoric can describe.

Cleon. I am happy in making you so acceptable a Present, my *Euphrosyne*; it is the largest and most delicate of all that are brought from the Indies.—There are ten or twelve different Sorts of them, and though some are more variegated with Colours, none have a Head decorated with a fine Yellow of the Citron Dye; none a finer Neck tinged with an Emerald Green; none can
boast

boast a genteeler Body, with Wings, and Tail, of the noblest Chestnut Brown, besides beautiful Tinges of Red, Green, and Gold, in many other Parts.

Euphros. I cannot but admire the Form and Colours of the Bird in general, but with regard to its fine long Tail, there is a singularity which I never observed in any Bird before, I mean the two very long Threads, which, like large Horse Hairs, go to a great Distance beyond the End of the Tail.

Cleon. The two Quills, in some Sorts of these Birds, have a little Plumage or Tuft at the End, which Curls two or three Times round, particularly in that which is called the *King of the Birds of Paradise*, but this is the smallest of all the Species, being not much bigger than a Swallow.—There have been several vulgar Errors and Stories propagated of this rare Bird.—One is, *that he has no Legs*, because they send them over to us with their Legs cut off.—Another is, *that they are not found till they are dead*; instead of which, they are often shot upon the Wing as *Birds of Prey*, especially in the Island of *Ternate*, where they abound.

DIALOGUE V.

Of the TOUCAN; RHINOCEROS-BIRD; WOOD-PECKER; the GODWIT, WOOD-COCK, and SNIPE; The FLAMINGO; HERON; CRANE; STORK; The BITTERN and CORMORANT; The PELICAN.

Euphrosyne.

I Find our Speculations on Birds are to be the Subject of a Lesson or two more yet, *Cleonicus*; pray what respectable Bird do we begin with to Day?

Cleon. The TOUCAN, my *Euphrosyne*, the most singular Bird in the World in regard to its *Bill*, which is six Inches and a Half long, two wide, and an Inch and Quarter in

Thickness at the Head, nearly equal to its whole Body, which is about the Size of a Wood-Pigeon. — Yet notwithstanding so wonderful a *Bill*, I find no Author says any thing of the Food he subsists on, or the Manner of getting it; in short, they give no Reason why this Bird above all others, should have a *Bill* of such an enormous Size. — Its Head is large to support such a monstrous *Bill*. — The upper Mandible or Part of the Beak, is of a bright Yellow; the Sides, and lower Mandible, are of a Red or Scarlet Colour to its Base, where it is purplish; these Colours are clouded more or less with Black, in here and there a Place — different Sorts of these Birds are of different coloured Plumage on the Body, Wings, and Tail, but the Colours most prevalent are Yellow, Green, Blue, and Black; greatly intermixed and variegated. — This Bird is not however the only Prodigy in Nature for a *Bill*, I shall shortly take you for a Walk to *Don Saltero's* Coffee-House at *Chelsea*, where you will see a great Number of the wonderful Productions of Nature, which will afford you the highest Entertainment, and among these, very large Bills of other Birds, and some of them more surprizing in Form than that of the *Toucan*. —

Euphros. I shall be very happy in spending an Hour so very agreeably. — You observe the *Bill* of the *Toucan* is most extraordinary for its Size; but you intimate some other Birds have Bills of a very unusual Form, *Cleonicus*; pray what Bird is most remarkable of this Sort?

Cleon. The RHINOCEROS BIRD, my *Euphrosyne*; so called as having a recurved Horn on the upper Mandible near the Head, and the *Bill* itself is very large, as you may see in this which I have now the Pleasure to shew you, and which will make another signal Article in your Museum.

Euphros. You will make me philosophically rich, before you have done, *Cleonicus* — you not only study to replenish my *Mind* with noble Ideas, but my *Museum* too, with the rarest Objects. — So I find we have *Rhinoceros Birds* as well as *Rhinoceros Beetles* — and pray what Country Bird is this?

Cleon. It is an *East-Indian* Bird, and lives principally on

on Flesh—it is called the BUCERUS, by the *Indians*; as the *Toucan* by the *Americans*, is called the *Brazilian Pye*.

Euphros. Now we are upon speculating Birds renowned for their Beak, what others are of eminent Note of that Sort, *Cleonicus*?

Cleon. There are no other Birds, that I know of, with notable Bills, but such as immediately indicate their Use; such for Instance, are all the *Wood-pecker* Tribe, the *Crane*, the *Spoon-bill Pelican*, &c.

Euphros. A *Wood-pecker* is an odd Sort of Bird, *Cleonicus*; I was much entertained the other Day, as I was walking by the Side of our Grove, in observing the comical Manner in which one of these Birds run up the Body of a tall *Elm-tree*—he was a most excellent Hand at Climbing, indeed.—It was quite a new Mode of Movement to me, and I thought, a very merry one really.

Cleon. I suppose you did not see any *Hole* which he had bored in the Body of the Tree.—But I shall take you for a Walk one of these Days, my *Euphrosyne*, in the *Wood-Lands*, where you will see a Number of Trees perforated in divers Places, and the *Holes* as geometrically round as if described by a pair of Compasses—for if you observed the Body of the *Wood-pecker*, which you saw run up and about the Tree, you will remember it was somewhat long and cylindrical, and consequently the *Holes* and *Form* of the Bird perfectly correspond to each other—for this Purpose, the Author of Nature has formed the Beak of this Bird, strong, round, sharp-pointed, and very hard.—A curious Ridge runs along the Top of the Bill to strengthen it—and for climbing, their *Thighs* are strong and muscular, their Legs short and boney; and their Toes two forwards, and two backwards, and near together.—All of this Tribe have a *hard stiff Tail*, bending downwards, on which they lean, and bear themselves up in climbing.

Euphros. What visible Proofs of infinite Wisdom, Power, and Design, does this one Species of Birds discover!

Cleon. And you will be still furnished with a Proof stranger, if possible, than all the rest, in the very singular Structure of the Tongue of this Bird, with respect to the strong Muscles and Bones by which it is moved, and

drawn out and in—the sharp, horny, bearded Point and the glewy Matter at the End of it, the better to stab, to stick into, and to draw out little Maggots, Insects, and other small Animals it lives upon, which it finds in decayed and rotten Trees.—The Flight of this Bird is not in a direct Line, but slant-wise, and bounding this way, and that.—One of the finest Species of this Bird is called the *Yaffol*, from it's Note in Flying.—It is most beautifully coloured and spotted with Yellow, Green, Blue and Black, variegated with different Hues;—the Size is from a Thrush to a Sparrow.—These Birds do so much damage to Timber-trees that Rewards are always offered for destroying them

Euphros. If that be the Case, *Cleonicus*, I shall beg of you to purchase one for my *Museum*.—But to proceed, are there any other Birds famed for their Beaks?

Cleon. There is a Sort of Fowl in *America*, called the *GODWIT* that is remarkable for a long Bill; but not much more so than our *WOODCOCKS* and *SNIPES*, whose Bills are perhaps the longest for their Size, of any Bird at all; and are evidently adapted to their peculiar Modes of Living, by sucking their Food out of boggy and marshy Places.—Moreover the *Manner of Flying* is very particular in these Birds, which is like that of the *Woodpecker*, by glancing very swiftly angular-wise, this Way and that, so that it is reckoned the highest Feat in the *Fowling Art*, to strike one of these Birds on the Wing, especially the Snipe.

Euphros. *Woodcocks* and *Snipes* being such fine Eating, subjects them to the same Fate with *Pheasants* and *Partridges*, that is, of untimely Death.—But their Flesh, delicious as it is, will not gratify the voluptuous Taste, so much as a critical Examination of the wonderful Form and Make of their Bills, Tongues, &c. will delight the inquisitive Eye.—And this, *Cleonicus*, will be the Case, the very next Time the Snipe or Woodcock falls into my Hands.

Cleon. After Birds of distinguished Beaks, let us next review those whose Necks and Legs are wonderfully large in proportion to the Body.—Among these the *FLAMINGO* stands foremost, as the most singular Bird in the World,
for

for this disproportion of Parts to the Body.—It is an *American Bird*, near the Size of a *Swan*—the Legs and Thighs together, are thirty Inches long—the Neck thirty-six Inches—the Neck and Legs very small for the Size of the Body—the Bill six or seven Inches long, and dentated at the Edges.—The *Feathers* of it's Wings are of the *deepest Scarlet*, and when flying, it makes a *glowing Phenomenon*, from whence it receives the Name.—The Make of this Bird shews it to be one of those whose Subsistence must be had out of deep Water.—The Flesh is excellent Food, but it's Tongue is esteemed the most dainty Morfel in the World.—The Note of this Bird is so loud, that you'd think it was the Sound of a Trumpet.

Euphros. I thank you, *Cleonicus*, for this fine Picture of the *Flamingo*, a Bird I never heard of before.—But if I remember right, the *Heron*, *Crane*, &c. are Birds also very remarkable for *long Necks and Legs*, and such I have viewed them in Prints.

Cleon. The *HERON*, my *Euphrosyne*, is a Bird, whose Beak, Neck, and Legs, are all of a great Length—from the Point of the Bill to the End of the Claws is four Feet.—It is nearly the Size of a Goose, and weighs about four Pounds.—By it's long Legs it wades in deep Waters, and with it's long Neck it can reach it's Prey.—Long Toes, with hooked strong Talons, to hold and grasp their Prey—a long sharp Bill, serrated and barbed towards the End, to hold their Prey very fast.—They have also very large Wings, to enable them to carry the greater Loads to their Nests at several Miles Distance.—They build their *Nests* on very high Trees; and in a *Heronry* where there are many together, it is very common to see a Number of *little Eels* running about upon the Ground, which fall from the Nests in feeding the Young.—This curious Particular I have observed myself with Pleasure at a Gentleman's House near *Southwold* in *Suffolk* —The *Heron* extends it's Legs in Flight, to counterpoise the Neck and Head—and is decorated with a fine Crest of Feathers upon it's Head, falling genteely backwards.

Euphros. Is not the *CRANE* near a-kin to the *Heron*, *Cleonicus*? It seems to be so by the Prints.

Cleon. The *CRANE* differs in many Particulars from the

the Heron — it is a much larger Bird, weighing about ten Pounds.—From the Tip of the Bill to the End of the Tail is five Feet—the Neck and Legs also are larger—tho' it does not feed on Fish, but on Seeds and Grain—therefore the Flesh is good and well-tasted.—They are found in great Flocks in *Lincolnshire*, *Cambridgeshire*, and other marshy Counties.—They are Birds of Passage—but whether they breed in *England*, is not yet certain.—Some Cranes Brought from the Indies have very fine Crests, of Bristles on their Heads, and make a stately Appearance.

Euphros. Pray, *Cleonicus*, how does the STORK differ from the *Heron* and *Crane*? They seem very much alike in their Forms.

Cleon. The STORK is about the Size of the *Heron*, but has a shorter and thicker Neck.—It is of various Colours in different Countries, but generally White, with long Black feathered Wings—the Legs are very long, Red, and naked a great Way up.—When it stands erect it is near four Feet high.—It generally rests upon one Leg, with it's Head turned upon it's Shoulders.—It's Bill is of a pale Red, about four Inches long, and pointed at the End.—It is a Bird of Passage also.—They make their Nests on the Tops of Houses, Chimnies and high Trees.—They live upon Fish, Frogs, and Serpents—are reckoned a fortunate Bird, and were adored in *Egypt* under the Name *Ibis*—They frequent Valleys, Marshes, Leaks, and Ponds.—It makes a loud snapping Noise with it's Bill.

Euphros. Unless a Person lives in a marshy Country, or near the Sea, it will be a difficult Matter, I find to have much Knowledge of these egregious Birds, personally—but I can take *Cleonicus's* Word, and Description in lieu thereof—therefore pray go on.

Cleon. The BITTERN and CORMORANT are two other Birds of the *Heron-kind*.—They are looked upon as Birds of bad Omen, and are always found in desolate, lonesome, moorish Grounds.—The *Bittern* is in Length from the Tip of the Bill to the End of the Tail, about thirty Inches—the Legs are long and bare of Feathers above the Knee.—It's Colour is a mixture of Brick-dust and brown or blackish Lines—the Feet are Green, with Toes large and strong—the Claws notched along the Middle, for holding

holding fast the Fish.—It lies concealed among Bulrushes and Reeds—and is known from all other Birds by a loud Noise, like a Stroke on a Drum-head.—It gives five or six of these boding Bombs at a Time, as I remember to have heard them.

Euphros. You give a woeful Idea of the *Bittern*, *Cleonicus*; pray what do you say of the other ill-fated Bird the CORMORANT?

Cleon. I have not much to say of that Bird, but only that it is more of the Goose Kind, having a long Neck and short Legs, with webb'd Feet, and strong Claws for grasping Fish.—The Colour on the upper Part of the Body is dusky, with a greenish shining Gloss; but the Breast and Belly are whitish.—It builds it's Nests on Rocks and Trees, in many Parts of *England*.—One Thing is singular in this Bird, and that is, that the *crystalline Humour* is Globous like that of a Fish, to enable it to see and pursue it's Prey under Water, which it does with great swiftness for a long Time together.—This Bird is a Species of the *Pelican Kind*.

Euphros. I have heard something strange of the PELICAN, but I scarce know what; please to recite it's particular Properties, *Cleonicus*, and what I mean will soon strike me.

Cleon. The PELICAN is a Bird of a large Size, weighing eighteen or twenty Pounds—the Bill is hooked like a Claw, and fourteen Inches in Length.—The extent of it's Mouth, wide open, about eighteen Inches—the upper Mandible or Chap is flat and broad; but the lower Chap is like two long Ribs, joined at the Extremity.—Between them there is a thick Yellow Membrane, like a Purse or Bag, growing down it's Neck.—This Bag it can draw up so close as not to be easily perceived; and at other times dilate it so far as to hold three or four Gallons—in this Bag it will carry as many Fish as will serve six Plowmen for a Meal.

Euphros. This Bag of the *Pelican* is the astonishing Particular I adverted to.—How various and wonderful are the Ways and Means with which Providence has endowed every Kind of Animal to procure it's Subsistence!

Cleon. We have in every object, a large Chapter of
divine

divine Revelation, the most *authentic Scripture*, which cannot be corrupted, perverted, or controverted by Man—the BIBLE of NATURE presents us with infallible Doctrines; and with the Force of Demonstration, commands our assent to, and creates in us a perfect Conviction of, the *real Existence of a DEITY*, as the *Author of Nature* in the boundless Extent of Universe.

DIALOGUE VI.

*Of the SWAN, and GOOSE; wild and tame
DUCKS; of POULTRY; PIGEONS; PATRIDGES;
and WHEAT-EARS.*

Cleonicus.

WE have hitherto been surveying the Beauties and Wonders of the feathered Tribe abroad, or wild at Home; now, my *Euphrosyne*, let us see what we can find worthy of Notice in our more *Domestic Fowl*, the Produce of our own Country, and which you are better acquainted with.

Euphros. This will be a most eligible Subject to me, *Cleonicus*; and pray which do you reckon, after the *Peacock*, the principal *English Fowl*?

Cleon. Undoubtedly the SWAN, my *Euphrosyne*; in point of *majestic stately Mien*, he is superior to every other Bird in Nature.—His *Gait in Swimming* is noble and superb; and he may be said rather to *sail* than *swim* according to the Poet.

*See! how yon Swans with snowy Pride elate,
Arch their high Necks, and sail along in State.*

Euphros. I have often beheld them in the *Thames* with wonder and Pleasure.—I seldom see them on their Legs walking, or upon the Wing in Flight, and yet I find them described by VIRGIL in taking long Flights; as in these Lines.

Like

*Like a long Team of snowy Swans on high,
Which clap their Wings, and cleave the liquid Sky;
When, homewards from their wat'ry Pastures borne,
They sing, and Asia's Lakes their Notes return.*

But pray, *Cleonicus*, did you ever hear a Swan sing? I have heard much of their Singing among the Poets; and you know the mournful Ditty, or the Ballad of the *Dying Swan*.

Cleon. As to their Singing, it is all *Poetical Fiction*, though *Pope* mentions it of the *dying Swan*, in his *Rape of the Locke*.

*Thus on Meander's flowery Margin lies,
Th' expiring Swan; and as he sings, he dies.*

Euphros. Now we are speaking of a dying Swan, pray is there any thing in the Story I have heard of their living 300 Years?

Cleon. This is also a *Fiction*, or rather a *vulgar Error*, though some of our greatest Naturalists have believed it; there is no Proof of any such *Longevity*, in a Swan or any other Animal.—They must be *wild Swans* that take great Flights.—Our tame ones take more Pride and Pleasure in *Swimming* than in either *Walking* or *Flying*, Nature having prepared them for one much better than the other.—The Swan is the largest *web-footed Water-Fowl* that we know—though it does not live on *Fish*, but on Water Plants, Roots, Seeds, &c. also on *Worms*, *Insects*, fresh Water *shell Fish*, &c.—Their Flesh is not admired, but is sometimes brought to the Tables of the Great, for *Ostentation* sake.—The Female lays five or six Eggs, and is two Months in hatching them; and this only once a Year.—The whole Body has a delicate soft Plumage, Grey at first, but White when grown.—The large Quills in a Swan's Wing are on many Accounts highly valuable—The Body of a middle sized Swan weighs about twenty Pounds.

Euphros. I am not high bred enough to relish Swan's Flesh; but for a young Goose, I think it excels most other Fowl—but this is *Epicurism*, instead of *Philosophy*.—Pray
Cleonicus,

Cleonicus, what is most remarkable in the Nature of a Goose?

Cleon. The Deliciousness of it's Flesh when roasted; for this is a real Philosophic Quality, and, more than any thing, distinguishes most of our domestic Fowl.—For what can be said much more of a Goose, or *Gander* rather, than that it is an *amphibious* Animal living by Land, and Water.—It eats almost any thing, but is fondest of Grass and Grain—the Colour is White in general in Geese, but always so in the *Gander*.—A good fat Goose weighs about twelve Pounds—when you anger them, they hiss at you like a Serpent.—The Goose lays Eggs three times a Year, and sits thirty Days—and the cruelty of human Beings is in nothing more notorious than in plucking these Animals alive, for the sake of their Feathers and Quills.

Euphros. Such Scenes of barbarity make me shudder.—Have you nothing, *Cleonicus*, of a more exhilarating Nature, by Way of *Antidote* for such melancholy Impressions?

Cleon. Indeed I have—Ducks you know naturally follow Geese.—Of tame Ducks we have no Intelligence extraordinary—but I shall relate an *Anecdote* concerning a Brother of yours being once most egregiously out-witted by a *Wild Duck*.—

Euphros. Why surely you joke, *Cleonicus*—but hold; this might be at a Time when this Brother of mine might be too young for a Philosopher.——

Cleon. Not so, truly—I think it no shame—the oldest, and, perhaps, the wisest Man living, would have taken what I saw for a *Lame Duck*.—The Case was this; I was walking one Day in a Piece of moorish Ground, at the farther End of which was a Pond under a Hedge—at about one hundred and fifty Yards from the Pond, I saw, as I thought, a very *lame Duck* wabbling and tumbling along before my Feet in the Grass (which was but short.)—I made no doubt but it was a *Stricken* Bird, and had a broken Wing or Leg, by its lamentable Looks and Shifts it made, by flapping the Ground with one *Wing*, and shoving itself along with one Leg, to make its Way from me, who was very eagerly pursuing to catch it—this I essayed to do often, and she was just as often at my Fingers Ends—but

—but still the wiley Creature evaded my Grasp, and kept Tumbling Head over Heels, but ten or twelve Inches before me.—I ran, I stooped, I reached, I made sure every Moment to lay hold of her, but the crafty Jade as constantly beguiled me,—and thus she continued hopping, limping, and waddling along just before me, till she came within fifty or sixty Yards of the Pond, when on a sudden she rose upon the Wing, cried *Quake, Quake, Quake*, and dropt upon the Pond, where the Young Ones were just arrived, swam across, and took Shelter under the Bushes of the Hedge.—I shall never forget how like a Fool I looked, to see myself lead such a *Wild-Duck Chase*, and so mortifyingly jilted at last.

Euphros. I am sure I should have laughed heartily, if I had been by, and observed the comical scene—but I beg your Pardon, *Cleonicus*.

Cleon. A Duck is a most guileful Animal; they are not only endowed with Deceit by Nature, but they learn Fraud and Treachery by Art, as witness the *Decoys*.—But to conclude this Episode, I cannot help making one sorrowful Reflection, that if we are so easily duped and gulled by the Natural Cunning and fraudulent Pretences of *Birds*, it is no wonder the ignorant Part of our Species are so generally decoyed by the pious *Frauds* and *Impositions* of designing *Men*.

Euphros. Well, from Ducks and Drakes I suppose you make a Transition to our *Poultry*, COCKS and HENS.—Pray what is peculiar in the Nature of them, *Cleonicus*?

Cleon. The CROWING of the Cock, the *Clucking* of the HEN, and the CACKLING of the PULLET when she has laid an *Egg*.—These are Faculties not to be found in any other Tribe of Birds, nor scarce any Thing analogous to them.—The Cock by *Crowing*, converses with his Brother *Chanticleers* at a great Distance, and gives us the Time of *Day-Break* in the Morning—he seems proud and highly pleased when you listen to his elevated Notes.—It has a noble *Crest* or *Comb* upon its Head, and under it, two famous *Wattles*.—The Body in general, is adorned with fine Feathers.—A beautiful shining Tail.—And Claws, and a Spur behind, on his Feet, which pronounce his *martial Fort* and *Genius*.—Since every one knows a Cock
is

is prone to Fight.—And Cock-Fighting thence has its Rise, to the great Disgrace of Human Nature.

Euphros. As to the CLUCKING of the HEN with her little ones about her, and her particular Cluck at finding a Grain, to give them Notice of it, I have oftentimes observed with silent wonder—she is constantly talking to them in her Dialect—and when the hostile Hawk appears to the View of her watchful Eye, she screams aloud, the Chickens take the Alarm, and immediately run under her Wings for safety, by a wonderful *Instinct of Nature*.

Cleon. The CACKLING of the Pullet or Hen when they have just laid an Egg, and come off the Nest, is a high Thing truly; it is, when interpreted, nothing more than this—“My good Dame, I have just presented you with an Egg, and desire to acquaint you with it, that you may come and take Care of it in Time, before the Stoat or Weazel defraud you of it; as I am given to understand, that you value the Eggs of your grateful Poultry, before those of any other Fowl whatever.”

Euphros. I think you have a very good Knack at decyphering the Language of Fowl, *Cleonicus*.—Pray what do the Pigeons say one to another, while they Walk around, and Coo to each other, in comical Gesticulations?

Cleon. Every Bird (as I observed of the Rooks) has it's particular Dialect of universal Language.—As for Pigeons, I believe they understand my native Tongue better than I do theirs.—They seem to be extremely fluent in Speech, and sociable in their Manners.—They are the only domestic Bird of Flight, and always fly together.—The different Orders of Pigeons are very numerous.—But those called the Carriers, are very remarkable, as they will carry Letters tied about their Necks to almost any Distance.—It was formerly a Practice to send Letters from Ships arrived at Scanderoon to Aleppo in Syria, by Pigeons brought from thence, to acquaint the Merchants therewith.

Euphros. But, for Goodness Sake, *Cleonicus*, how could these Birds find their Way back again, over so vast a Tract of Land?

Cleon,

Cleon. They are directed by the unerring Hand that made them—it is impossible to Account for it any other Way—Of the *Pigeon Kind* you may reckon *DOVES*, which are still of a more loving and amiable Nature, and always associate in Pairs of the different Sexes—and when one dies, the other leads a solitary and inconsolable Life.—

Euphros. Pray what is that you call the *Turtle*, or *Turtle-Dove*, *Cleonicus*?

Cleon. The *TURTLE* is a Species of *Pigeons*—but are Birds of Passage, and said to be Natives of India, though they breed with us before they return.—They delight in plain open Countries, and build their *Nests* in high Trees.—But they will live here all the Winter, if kept in *Aviaries* and *Cages*.

Euphros. Pray, *Cleonicus* do you reckon an *Owl* a domestic Bird? for they are found in every Farmer's *Barn*.

Cleon. The *OWL* may be justly esteemed so with us.—It is a *Bird of Prey*, as it generally lives on *Mice*, which it catches in the *Barn*, &c.—The *Owl* is reckoned a Bird of ill Omen; especially that called the *Screech Owl*, which by its dismal screeching Noise, alarms and terrifies the Country People much.—The *Owl* is the only *Bird of Night* we have; they not only shun *Day-Light*, but even strong *Moon-Light*.—The *Owl's Face* is in *Front*, not in *Profile*, like other Birds.—The two *Eyes* therefore look forwards, as in a *Cat*.—There are many very beautiful Species of this Bird in foreign Countries, adorned with fine Colours, Crests, Horns, and rich Plumage in every respect.—This Bird has such a demure, grave, and wise Aspect, that it has been consecrated to *Minerva*, the Goddess of Wisdom.—An Honour too great, I think for *Hooting Margery*.

Euphros. So I think too.—But you say nothing yet of the *Partridge*, *Cleonicus*.

Cleon. The Reason is, you know as much as I can tell you of that choice Bird.—That he has the Faculty of making *Fools* of Mankind, as well as the *Wild-Duck*; and then—Of making a *Feast* for them, by way of Atone-ment, as the *Duck* also does, is well known by Experience.

Euphros. What are those Birds called *WHEAT-EARS*,
VOL. III. K *Cleonicus*?

Cleonicus?—I have heard them cried up for the very finest of Eating.

Cleon. They are little inferior to the ORTOLANDS brought from *Italy* and *France*—but is somewhat less in Size, the Wheat Ear being not bigger than a *Hedge-Sparrow*.—They are Birds of Passage, and come to us in *Wheat-Harvest*, which is the Reason of their Name.—They are in great Plenty about the South Downs in *Sussex*, where they are taken in Traps in a Hole in the Ground, with a Tile over it.—They are potted in great Quantities at *East-Bourn*, &c. and sent up to London, as the greatest Dainty England affords.—Whence they come, and where they go to, is not known.

DIALOGUE VII.

Of INCUBATION—NIDIFICATION—and MIGRATION of BIRDS.

Cleonicus.

THE Subject of our present Converse, my *Euphrosyne*, will be a few Reflections on the *Wonders of Nature* displayed in the Affairs of INCUBATION, NIDIFICATION, and MIGRATION of Birds.

Eupros. These are all grand and agreeable Subjects, indeed, *Cleonicus*; I shall with much Pleasure attend to what you say of each.—I suppose the Doctrine of *Incubation* contains every thing relative to *Eggs*, and the Manner of *Hatching* them.

Cleon. It does so, my *Euphrosyne*; and there are no Birds but what lay Eggs, and are produced from them one Way or other, for the Method by *Incubation* is not *universal*, though generally the Means made use of by Nature for that Purpose.—It may be observed of Eggs, that they are larger or smaller as the Birds are so which lay them.—Thus the Egg of an *Ostrich* is the largest of any, because the Bird is so, being five Inches long and four Inches thick, more or less.—But on the contrary, those of the Humming Bird are but the Size of *White Peas*,
the

the smallest of all we know.—The Ostrich's Egg is therefore about one thousand Times as big as the other, and as it is the principal Phænomenon in Nature of this Kind, I have procured one of the largest for your Repository, Sister.

Euphros. This is a curious Present, indeed! why, People will think me half a *Connoisseur* by and by, *Cleonicus*.—

Cleon. Suppose they thought you wholly so, where is the harm of it? Is it any more shame for my *Euphrosyne* to be esteemed a *Connoisseur*, than it was for the beautiful HYPATIA, to be the most celebrated *Mathematician* of the unworthy Age she lived in?—You have already been instructed in the *Philosophy of Hatching of Eggs*, by many Experiments upon the *Air-Pump*; so that now a few Reflections more on that Head will suffice.

Euphros. I well remember every Experiment of that Sort, to a Tittle; and convincing Ones they were.—So that now, *Cleonicus*, I need not detain you on that Head, therefore pray proceed.

Cleon. Though every Species of Birds lay Eggs, they are not always laid in a Nest, or hatched by Incubation.—For Instance, the first of Birds is said to be an Exception in both Respects.—The Ostrich is mentioned by the learned and most ancient *Naturalist* in the World (the Author of the *History of Job*) as leaving her Eggs in the Earth, and warming them in the Dust (or Sand of the Desert, Chap. 39.)—But this Mr. KOLBEN affirms is a Mistake; he had seen great Numbers of them at the Cape of Good Hope; and also seen them sit on their Eggs like other Birds,—and that the Male and Female take it by Turns, as he had frequent Opportunities of observing.

Euphros. I find this Old Author of yours does further affirm that she is hardened against her Young Ones, as though they were not hers; what does Mr. KOLBEN say to that, *Cleonicus*,?

Cleon. He says, that is an ancient and vulgar Error also; for he assures us, the Young Ones after they are hatched, are not able even to walk for several Days; during which Time the Old Ones bring them Grass, and are very careful in

defending them from Dangers, insomuch that it is not safe for any Person to come near them at that time.—Other late Authors tell the same things of the *Ostriches* in *America*.—See *Phil. Transf.* No. 82, at your leisure; where mention is made also of her Nest.

Euphros. As Warmth is the principal Agent in this Affair of Hatching Eggs, I should think the same Degree of Warmth communicated to them and continued the proper Period of Time, would produce the same Effect, or hatch the same Eggs, what say you, *Cleonicus*?

Cleon. I say you are very right, my *Euphrosyne*; and it has been a Practice in *Egypt*, from Time immemorial, to put Eggs into *Dunghills* and hatch them by the Warmth thereof.—After this they contrived to hatch them in *Ovens*, heated to a proper Degree—these Ovens were of different Sizes, holding from forty to eighty Thousand Eggs each—they are worked about six Months in the Year—in this Time they can Produce eight different Broods of Chickens, as twenty-one Days is the Time of a Hen's Sitting.—Hence there are bred in *Egypt* about ninety-two and a Half Millions of Chickens yearly.—But of late Years this Art has been vastly improved by Mr. *Reaumur* in *France*, and reduced to a Science by Means of the *Thermometer*, which you know will indicate any Degree of Heat or Warmth required, which for a Hen, and all other Birds, is marked thirty-two in his *Thermometer*, and ninety-six in *Fahrenheit's*.—After the Young are hatched it is generally a Day before they eat any Thing, and then a few Crumbs of Bread for a Day or two will suffice, as they will be able to pick up Insects, and Shift for themselves.

Euphros. Why you surprize me, *Cleonicus*; this Scheme is not only a very curious One, but must be a very lucrative One at the same Time.—From twenty Eggs in twenty Days, you have twenty Chickens; why that is every Day a Fowl for Dinner with little or no Cost.—Why don't the Country People, especially the poorer Sort take to this Method for Support, instead of Hard Labour?

Cleon. One Half know nothing of the Matter; and the other Half are so ignorant and indolent, that they will never attempt any Thing out of the Common Way.

—But

—But now my *Euphrosyne*, let us advert to another very wonderful Faculty in Birds, which is the curious Art of MAKING A NEST, with such Variety of Materials, disposed in such an exquisite Manner and Order, and in so many different Ways, as we observe them.

Euphros. I have always viewed a BIRDS NEST with the highest Admiration.—The Spiders *Web*, and Bees *Honey-Comb*, and the Birds *Nest*, are singly sufficient to convince the most stupid *Atheist* of his senseless Error, if in the least attended to.—Such astonishing Instinct in Birds, reminds me of *Prior's* Lines:

*Of Birds, how each, according to her Kind,
Proper Materials for her Nest can find;
And build a Frame, which deepest Thought in Man
Would or amend or imitate in vain.*

Cleon. The Subtily of Birds in making their Nests has been a most celebrated Theme for Naturalists and Poets to discant upon in every Age.—“With what inimitable Art (says Dr. DERHAM) do these poor untaught Creatures lay a parcel of rude and ugly Sticks and Straws, Moss and Dirt together, and form them into a commodious Nest? With what Curiosity do they line them within, wind and place every Hair, Feather, or Piece of Wool, to guard the tender Bodies of themselves and young, to keep them warm? And with what Art and Craft do many of them thatch and coat their Nests without, to dodge and deceive the Eye of Spectators, as well as guard and fence against the Injuries of Weather? With what prodigious subtilty do some foreign Birds not only plat and weave together the fibrous Parts of Vegetables, and curiously tunnel them, and form them into *Nests*, but also artificially suspend them on the tender Twigs of Trees to keep them out of the reach of rapacious Animals.”

Euphros. These Reflections of the Doctor's are very ingenious, and very affecting; is it not surprizing, *Cleon*, that any Man can be so blind, as not to see the Hand of a *Divine Architect* directing them in constructing such wonderful Works? This *Hanging-Nest* is a Miracle of Sagacity in Birds!

Cleon. And you will still be more convinced of that, my *Euphrasyné*, when you inspect the *Hanging-Nest* I have now the Pleasure to shew you,—Here it is, view it well.

Euphros. Truly this is the most wonderful Thing I ever yet saw.—Three long Leaves sewed together by their Edges—wide on the Top, where the little Nest is placed, and tapering to a Point at the Bottom—the slender *Cotton String* by which it was suspended from the Twig.—Nay, I see the very *Stitches* in the Sides of all the three Leaves.—Are you sure, *Cleonicus*, that this is the Work of Nature, and not an Imposition by Art?

Cleon. It was a *Surgeon* of an *East Indiaman* who gave it me.—He said they were common in the Country where he was—and all constructed in like Manner.—There are many of these hanging Nests from *America* to be seen in the Repositories of the Curious; but I don't remember I ever saw, or heard before, of a *Leafy Nest* in this *triangular Form*.—That they suspend them from the Boughs of Trees out of the reach of *Apes*, *Serpents*, &c. is a Matter of great Notoriety in both the *Indias*.—And I am particularly happy in presenting my *Euphrosyné* with so uncommon a Specimen of the Miraculous Performance of Birds.

Euphros. I grow rich apace, in Natural Curiosities, *Cleonicus*; the Nests of the long-tailed *Titmouse*, and *Wren*, I have ever looked upon as the most stupendious Works of Natural Art, but this Indian Nest exceeds every Thing.—There is one Thing yet remaining, in regard to Birds, *Cleonicus*, which I should be glad to have your Opinion about, and that is, where *Birds of Passage* go to, when they leave us?

Cleon. How these Birds should know where to go to, and when; and also how to steer their Flight upon the right Point of the Compass, are Questions that can be resolved only into the divine Destination of Providence.—It was observed as long ago as *Homer* lived, that *Cranes* went from Europe to *Egypt*, as described by him in the following Lines,

*So when from Strymon's wint'ry Banks, the Granta
In feather'd Legions, cut the ætherial Plains;
To warmer Nits they bend their Airy Way,
Form'd in long Lines, and rank'd in just Array.*

—It is remarkable that all Birds of Passage are accommodated for that Purpose with long and strong Wings.—That they all of a Species assemble together a few Days before hand, to consult about their Departure.—A Gentleman of great Veracity assured me, he at once saw at least near three Hundred Cuckoos assembled together in a large Field for that Purpose.—Quails have been often seen going across the Seas from Europe to Asia; and also Storches, &c.—But the greatest Question of this Sort is, what becomes of Swallows when they take leave of us?—The Answer to this Question is not a little surprising and Paradoxical.—An Arch-Bishop first asserted they went to the frozen Climes, and lay together in Clusters under the Ice, in a torpid State all the long Winter—that they were often in this State drawn out of the Lakes by Fishermen, and when brought into a warm Room, would revive and fly about and appear to be real Swallows.—Etmuller, the great Physician, says, he found many such coagulated Clusters of Swallows himself.—And so lately as 1713, Dr. Colas declared before a Meeting of the Royal Society, that he saw sixteen Swallows so drawn out from under the Ice in the Lake of Samrodt; and thirty out of the great Pond at Rosineilen.—Yet notwithstanding all these Ocular Witnesses, so strange a Doctrine cannot obtain Credit with some late Writers on Birds.

Euphros. Indeed, *Cleonicus*, I don't much wonder at it.—That Swallows should come here for Warmth, and go there to be frozen, is such a Contrariety, that I protest I cannot tell what to think about it myself, till I know your own Opinion of the Matter.

Cleon. This I am sure of, my *Euphrosyne*, if we do not believe what People of Credit assert they have seen, there can be no Ground for any Faith at all.

Euphros. There is one Animal of so ambiguous a Nature, that I know not whether I may call it a *Quadrupede*,

or a *Bird*; I mean the *Bat*, *Cleoniceus*, of which you have yet said nothing.

Cleon. It would be almost improper to say any thing of the *Vespertilio* or *Bat*, till after I had passed the Descriptions of *four footed Beasts and Birds*, because the *Bat* is most evidently a *Transition* from One to the other, as the *Grylotalpa* connected the *Quadrupede* to the *Insect*.—Nature abhors a *Chasm* in her Works.—The *Bat* has the Properties of a *Mouse* in regard to *Body, Shape, Colour, and Clothing*; but has the *Faculty of Flying* in Common with *Birds and Insects*.—It's two hind Legs are those of a *Mouse*.—The two Fore Legs are connected with a large Membrane from the Body, on each Side by which it can fly as with two Wings.—And at the End of each Fore Leg, is a sharp strong Hook, by which it can walk on *all-fours* as *Quadrupedes* do, and also lay hold on its Prey or Food, whatever that may be.—This is rather an *Evening* than a *Nocturnal* Animal; and because it is then seen fluttering about, the Peasants call it a *Flutter-Mouse*.—The *Virginian Squirrel* is another Instance of that vast Deviation from *Nature's ordinary Way* (as Dr. DERHAM terms it); and is truly a *Quadrupede*, with the Skin spread between, and connected with, the two Fore-Legs;—being thus furnished with large Membranous Wings, it flies from Tree to Tree, collects the Fruit, which it holds in its two Fore-Feet, as with two Hands, while it eats it, as other Squirrels do.—One of those *Bats and Squirrels* I shall shortly procure to enrich my *Euphrosyne's Museum*.

DIALOGUE

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART III.
CONTAINING

A General SURVEY of FISHES.

DIALOGUE I.

Of the peculiar NATURE, FORM, SIZE, and PARTS
of the BODIES of FISHES. Of their ORGANS,
of SENSATION; FACULTIES of SWIMMING,
&c.

Cleonicus.

AFTER our Survey of the principal Inhabitants of
the EARTH and AIR, let us now contemplate the
Nature of those which are peculiar to the Element of
WATER.

Euphros. This will be a Multiplication of those Plea-
sures that delight the Mind in exploring the Marvelous
Works of the *Almighty Creator* of the World; and there-
fore, *Cleonicus*, in the glorious Speculations you propose,
immediately proceed.

Cleon. A FISH is an Animal destined to live in WATER,
Salt or Fresh; and its proper Mode of *Movement*, that
of

of SWIMMING.—This Motion is performed by FINS, not by Legs or Feet.—These Fins are placed on different Parts of the Body of a Fish; but made in such a Manner and Form, and so disposed for any Degree of Motion, in any Direction whatever, that infinite Wisdom alone could direct:

Euphros. I shall never forget the most beautiful Structure of such a *Fin*, when sometime time ago you shewed me the Circulation of the Blood in it:—How delicately constructed with Bony Ribs, and jointed at proper Distance—the curious Membrane that connected them.—The Blood-Vessels, and others which pass through them—and the fine bespeckled Skin which covered the whole, and gave it the Appearance of transparent burnished Gold.

Cleon. The Idea you retain of the *Fin* is extremely just and accurate, my *Euphrosyne*; these *Fins* are all moveable by strong *Muscles of Flesh* appropriated to each, as the Limbs and Parts of all other Animals are.—These *Muscles* make as it were the whole Body of the Fish—supported by a most wonderful *Skeleton or System of Bones* throughout.—Of which there are *Ribs* to form the Body, and a Multitude of other small Bones to give Strength and Support to the fleshy *Muscles*.

Euphros. Why in truth, *Cleonicus*, whenever I eat Fish, I verify what you say; for there are such an incredible Number of small Bones, especially in Roach, Carp, &c. that I even eat them in fear of my Life.

Cleon. You cannot be too careful in that Respect.—By a Gentleman who was at the Pains to compute them, we are told there are about three thousand in a *Carp*.—The strength of a Fish is surprisingly great as well out of Water, as in—and the Mechanical Rationale of Swimming is the same as that of Flying in Birds; for the latter fly by striking the Air with their *Wings*, and the former swim by striking the Water with the *Fins*; since as much as they strike the Water backwards, the Water reacts, and strikes them forwards with equal Force.—The *Fins* near the Belly generally serve for this Purpose; and those on the Back, and Tail, principally for *Steerage*.

Euphros. As a Fish is to move through so dense a Medium as Water, I make no doubt, *Cleonicus*, but the infinitely

nately wise Former, has given it that particular Figure which meets with the least Resistance from it.

Cleon. You judge, my *Euphrosyne*, not only very rationally, but it is demonstrably *Fact* by human Sagacity.—For Sir *Isaac Newton* investigated the Form of a Solid that would meet with the least Resistance from the Fluid in which it was to move, and it appeared to be that of a Fish, particularly the Head Part, very nearly.

Euphros. In the Head of a Fish I see there are *Eyes*, but I find nothing that I can suppose to be *Nostrils* or *Ears*, *Cleonicus*, which are very obvious in all kind of Birds.

Cleon. I allow there is not the least Appearance of *Ears*, but still it will not follow from thence, that a Fish must be surd or deaf; for it is known by Experience, that *Carp* and *Tench* are called to the Side of a Pond by a loud *Whistling*, to receive their Food thrown into the Water.—And it is no great *Paradox*, if Fish should bear without *Ears*; since Omnipotence is not confined to one particular Mode of Organization to produce any one Sense at Pleasure—perhaps you may have, e're long, some Instances of Animals seeing without Eyes.—As to *Nostrils* and *Smelling*, in common Fish, we know little, if any thing about them.—For the Method of *Respiration* here is by passing the Water, and the Air contained in it, through the *Gills* in each Side of the Head, which are in lieu of the Lungs in Quadrupedes.

Euphros. Then it is this Art of Respiration in Fishes, which I see by the Opening of their Mouths so often and so constantly, to receive the Water and Air, which they respire through their Gills (if I may so speak,) is it not, *Cleonicus*?

Cleon. Indeed it is, my *Euphrosyne*; and you will observe by your little *Gold* and *Silver Fishes* in your Glass Bowl, that they respire the *Water* much quicker than we do Air.—This *Aqueous Respiration* in them keeps up the *Vital Flame*,—the *Air-Pump* will not deprive them of it, and therefore will not kill them; but the *Water-Pump*, by taking away the Water, soon makes them expire.—Though they live much longer out of Water than we do in it.

Euphros.

Euphros. The *Tongue* of Fishes shews they have a *Sense of Taste*, as in other Animals.—But what I have often observed in regard to their Eyes, is, that the Ball of the Eye seems to be quite round, and looks like a small White *Ivory Globule*, when boiled out of the Head.

Cleon. The EYES of Fishes are in general, perfect *Globules*, in Order that the *Focal Distance* may be very *short*, and of Course, the *Vision* very *distinct* of Objects near at Hand; they also have the Power of adjusting the *Spherical Crystalline* for distant Views likewise.—The Eyes of Fishes are nearly opposite to each other, whence they see all around them.—They are remarkably *quick-Sighted*.—And the Eyes of Fishes are exquisitely guarded by a strong horny Circle proceeding from the *Sclerotica*, and decorated with a fine coloured *Iris*, which gives a lively and splendid Appearance to the Fish.

Euphros. Well, now for the SIZE of Fishes; I suppose, *Cleonicus*, you have a much larger *Scale of Gradations* here, than in any other Kinds of Animals, by what I have heard in common Discourse.

Cleon. A much larger indeed, my *Euphrosyne*—from the largest *Whale* to the least *Minnew*, is a vastly greater Disproportion of Magnitude than can be found in the whole *Compass of Nature* besides! I speak here of only such as are sensible to us, without the Help of a Microscope on one Hand, and the Indulgence of Conjectures on the other; or else this Scale of Difference would become altogether inconceivable in Fishes.

Euphros. I suppose, *Cleonicus*, in this most extensive Tribe of Beings, you find it difficult to make any proper Arrangement, and Distribution of them, in *Species*, *Orders*, *Classes*, &c.

Cleon. So much, my *Euphrosyne*, that I shall not attempt it.—It may suffice for our Purpose to distinguish them according to their different Clothing; for some are covered with *thick Skins* quite bare, as all the larger Sort from the *Whale* to *Porpoise*.—Others are covered with *Scales*, as all the common Sorts—and lastly, those are called *Fishes* also, where the whole Covering consists of hard testaceous Substances, or Shells; as *Muscles*, *Oysters*, *Crabs*, and innumerable others.

Euphros.

Euphros. I believe no Shell-Fish swim, properly Speaking, *Cleonicus*; for *Oysters* &c. certainly do not; and *Crabs* and *Lobsters* have *Legs* to walk, and no *Fins* to swim; and *Muscles* grow in large Clusters to Rocks, as *Fisher-Men* have informed me.—These all seem to me to be very *Anomalous Sorts of Fishes*.

Cleon. They are Objects very dissimilar to the *Scaly Tribe*, as you rightly observe; but there is another Sort of Fish yet, which we rather call *EELS*, though they have both *Scales* and *Fins*, and sometimes swim. ought, I think, to be reckoned a Kind of *Serpentine Fish*, because their *Form*, and most *natural Motion* is the same as that of a *Serpent*.

Euphros. If I don't Mistake, a Fish is quite a *Mute Animal*, is it not, *Cleonicus*?

Cleon. I do not remember that I have ever heard them emit the least Sound, Note, or Voice—indeed they have no Organs for this Purpose, nor do they live in an Element proper for it.—And yet they are observed to be very sociable Animals, and always go together in great Shoals and Companies—there is no doubt but they can converse with each other in a *silent Sort of Language*.—There are *Fish of Passage* among them, as witnesses, *Pilchards*, *Herrings* *Maccarel*, &c. which come from the Frozen Seas into our warmer Climes every Year; and supply your Table with so great Variety of dainty Dishes.

Euphros. Many Sorts of Fish are delicious Eating, but I have been told that the *Flesh of Fish* is not so nourishing, as that of *Quadrupedes* and *Fowls*, what say you, *Cleonicus*, to that material Article?

Cleon. It is the Opinion of all the Faculty, and it seems very justly founded; as the Nature of Fish is to abound in a gross Sort of Oil and Water, which have but few Volatile Particles, it is less fitted to be converted into the Substance of our Bodies, than the Flesh of other Animals which abounds with warm, active, and Volatile Principles, much more proper for our Aliment.—Indeed for *weak* and *valetudinary Persons*, Fish are a more proper Diet in general than strong Meat, and then those which are *boiled*, are the best.

Euphros.

Euphros. Well, Thanks to Heaven, I only eat them for Change of Diet, and they make a very savoury Dish; but our present Business is not Luxury.—I think, *Cleonicus*, in a Fish I see the greatest *Singularity* in Nature, I mean the *Air-Bladder*.—But I remember you shewed by an Experiment on the *Air-Pump*, that this Bladder, by being too much expanded prevented the Fish from *descending* in the Water, by encreasing its Bulk beyond its due Degree, and thereby making it too light for Swimming any where but at the Top of the Water.

Cleon. And from thence my *Euphrosyne* perceives the Necessity of such an Artifice to make the Fish boyant at all Times to a proper Degree.—For the Fish having a Power to dilate or contract this Bladder, and consequently the Bulk of its Body, can make itself lighter or heavier, and therefore *Swim* or *Sink* at Pleasure.—All this is but the Reverse of the Experiment which you saw of the *Glass Balls* and *Images* going up and down in the Jar of Water at the Word of Command.

Euphros. I see it is—by encreasing the *Weight* in one Case, and the *Bulk* in the other, the same Effect of *Sinking* and *Swimming* is produced.—Pray, *Cleonicus*, can you tell to what Age a Fish may live?

Cleon. It is said by *Naturalists* that the Years of a Fish's Age is known by the Number of *concentric Circles* upon its Scales.—The Scale therefore of a *Carp*, that is Half an Inch in Diameter, will be found to contain about one hundred of these Circles; and hence such a *Carp* is concluded to be a hundred Years old; and indeed, it is known by common Experience, that Fish in general live to a great Age, their Lives being one uninterrupted Scene of *Ease*, *Tranquility* and *Pleasure*, the great Principles on which *Longevity* in Man, and most other Animals, depends.—But after all, I do not suppose, from what I have seen, that there is any great Stress to be laid upon this Notion of *Concentric Circles in Scales*; or that there is any certain *Criterion* of a Fishes Age, in any Part of its Body.—For a Conclusion of our present Dialogue, I believe you will allow the following Queries of *PRIOR* to be very pertinent.—

Of

Of Fishes next, my Friends, I would enquire,
 How the mute Race engender, or respire;
 From the small Fry that glide on Jordan's Stream,
 Unmark'd, a Multitude without a Name;
 To that Leviathan, who o'er the Seas,
 Immense rolls onwards his impetuous Ways,
 And mocks the Wind, and in the Tempest plays?
 How they in warlike Bands march greatly forth,
 From freezing Waters, and the colder North;
 To Southern Climes directing their Career,
 Their Station changing with th' inverted Year?
 How all with careful Knowledge are endued
 To chuse their proper Bed, and Wave and Food,
 To guard their Spawn, and educate their Brood?

DIALOGUE II.

Of the KRAKEN or Animated ISLAND. Of Ce-
 taceous FISHES, or WHALES. Of the Green-
 land WHALE; and the Method of TAKING one,
 by the HARPOONIERS.

Cleonicus.

WE are now, my *Euphrosyne*, entering upon the
 Dominions of NEPTUNE, to reconnoitre the
 Regions of the OCEAN, and to explore the NATIVES, or
 rather the MONSTERS of the Great DEEP, as the mo-
 mentous Subject of our present Speculations.

Euphros. This will be a Theme of Dignity and Gran-
 deur indeed, *Cleonicus*; I must call up all my Powers to
 enable me to give suitable Attention to your Discourses on
 such sublime Topics of Natural Science.

Cleon. The WHALE, my *Euphrosyne*, is the Wonder
 of the World! and is undoubtedly the largest Animal that
 we have any certain Knowledge of in the whole Compass
 of CREATION.—It has been thought to be the *Leviathan*

of

of *Job*, but there are several Parts of his Description that do not agree to the *Whale*, and one very Essential, the *Scales*, for the *Whale* has none; yet these are said to be the *Leviathan's PRIDE*.—However Dr. *Broom* has described the *Whale* under that Character in the subsequent Lines.

*There huge Leviathan unwieldy moves
And through the Waves a living Island roves;
In dreadful Pastime terribly he sports,
And the vast Ocean scarce his Weight supports;
Where e're he turns, the hoary Deeps divide,
He breaths a Tempest, and he spouts a Tide.*

Euphros. This is a beautiful Description of such a surprising Creature; and I beg leave, *Cleonicus*, to second it with another from a truly philosophical Poet.

*Here the huge Portent of the scaly Train
Enormous sails incumbent o'er the Main
An animated Isle, and, in his Way
Dashes to Heav'n's blue Arch the foaming Sea:
When Skies and Ocean mingle Storm and Flame,
Portending instant Wreck to Nature's Frame,
Pleas'd in the Scene he mocks, with conscious Pride,
The volley'd Lightning, and the surging Tide;
And while the wrathful Elements engage,
Foments with horrid Sport the Tempest's Rage.*

Cleon. Very poetical indeed, my *Euphrosyne*. You observe in both these elegant Descriptions of the *Whale*, that Monster is metaphorically represented as an *animated Isle*, or *living Island*.—But what would you think, if you were told, that there was really (without a Figure) such a Thing in Nature as an *animated Island*? And that such a Doctrine, strange as it is, has been related, credited, and supported, by a great *Naturalist*, and *BISHOP* into the Bargain, if that weighs any Thing?

Euphros. Why to be sure, *Cleonicus*, whatever so great a *Philosopher* and *Prelate* believes, and asserts as probable, our Sex, at least, ought not to dispute or call in Question; but

but who, for Goodness Sake, is this Philosopher of yours, with such a prodigious Faith?

Cleon. No less a Personage than the late celebrated ERICK PONTOPPIDAN, BISHOP of *Bergen*, in NORWAY. This Right Reverend Naturalist wrote a large and curious *Natural History of Norway*; which has been translated from the *Danish* Original in a Folio Size.—In this History we find Matter enough to exercise even the most elastic Credulity in *Natural Objects and Phænomena*, among which the principal is that called the KRAKEN, which makes its Appearance in Form of a *Floating Island*.

Euphros. A *Floating Island*, *Cleonicus*! pray let me ask you two Questions, is it probable any living Creature should be so large as to be properly compared to an Island? And 2d. Is it possible for an Island to float?

Cleon. With regard to your first Query, my *Euphrosyne*, I answer, the Probability of a Thing does not depend on its Magnitude.—To the 2d. Query, I aver, it is impossible for an *Island to float*, because it consists of *Earth*, which is heavier than *Water*.—Therefore as the People of *Norway* and *Lapland* have from Age to Age seen something in the Ocean which *appears* and *disappears* at different Times of the Year, in the Form of an Island, covered with Weeds, Moss, Grass, Shrubs, &c. not less than a Mile in Diameter, as it cannot be an Island, what can we suppose it to be but an Animal?

Euphros. I really cannot tell what to say, nor how to think about it, *Cleonicus*; I am not weak enough to suppose there is any thing in Magic; or else I might have been led to think it an *Inchanted Island*.

Cleon. That is the very Idea which the vulgar have of it through all the Country; they suppose it to be inhabited by Witches, Demons, and Spirits; and that all the strange Phænomena of this supposed Island were the real Effects of *Witchcraft and Incantment*.—These were the principal Motives to induce our Right Reverend Prelate to think it was very probably an Animal of the *Polypus Kind*.—My *Euphrosyne* has now an Opportunity of pinning her Faith upon a Lawn Sleeve, or not, as she likes it.

Euphros. I shall take a little more time to consider of so uncommon a Subject, before I engage my Belief about it.—In the mean while, *Cleonicus*, let us revert to the *Whale*, and tell me what you know of that stupendous Work of Omnipotence.

Cleon. The first Thing that attracts our Attention in that Creature is it's enormous Size.—It is credibly reported that some have been seen near a hundred Feet long.—But those commonly taken about *Spitzburgen* in *Greenland*, seldom exceed sixty Feet in length, and between twenty and twenty-five in Thickness, or Depth.—The Length of its Mouth is about eighteen Feet, and the Extent or Width of his Tail as much.

Euphros. What a wonderful Creature is a Whale! I think you observed just now *Cleonicus*, that a Whale has no Scales.

Cleon. All Fish of the *Whale Kind* are covered with a Skin quite bare.—One that was left at low Water upon the Side of the Thames, a little above *Deptford*, a few Years ago, was near sixty Feet long; and had a Skin about six Inches thick upon the Back, where it was cut away in many different Parts for the Blubber.

Euphros. Pray *Cleonicus*, what Sort of FINS has a Whale?

Cleon. The largest Sort of Whale has but two, one placed on each Side the Body behind the Head, in Form like those of other Fish; but in Size, proportionably large with the Body.—Some Species of Whales have a large Fin on the Back.—The Tails of all consist in a large Fin posited horizontally.

Euphros. I suppose the Eyes of a Whale are monstrously large and Glaring, are they not, *Cleonicus*?

Cleon. Nothing like what you may very reasonably imagine, my *Euphrosyne*; I saw the Eyes of that at *Deptford*, and they were but little bigger than those of an Ox. The Parts of the Eye were loose and flabby.—The Glassy Humour of an Ox's Eye, is much more consistent and transparent, than that of the Whale.—The Crystalline of an Ox, infinitely exceeds that of the Whale—and the Retina in the Eye of the Whale bears no Comparison to that of an Ox for Beauty and Regular Expansion.

Euphros.

Euphros. I wonder at such disproportion; but upon second Thoughts, as Vision does not depend upon the Size of the Organ, the Wonder vanishes.—Pray, *Cleonicus*, had the Whale you speak of any EARS?

Cleon. I don't remember to have seen any; yet Naturalists say that Whales *Hear*, though none describe their Ears.

Euphros. Has it any NOSTRILS, *Cleonicus*?

Cleon. It has two Holes on the Top of it's Head, through which it spouts Water to a prodigious Height in the Air.—If these are *Nostrils*, so be it, I know of no other, my *Euphrosyne*.

Euphros. Pray what Sort of TEETH have Whales, *Cleonicus*?

Cleon. That called the *Balæna*, or largest Sort, has none; as they swallow every thing whole.—Their Throats are very large, and Fish of seven Feet length have been found in their *Stomachs*.—Their *Mouths* are so large, that an Ox will not fill one—but their Tongue is small in proportion.

Euphros. I suppose our *Whale-Bone* comes out of a Whale, *Cleonicus*; but pray what Part is it found in?

Cleon. The *Whale-Bone* is all contained in the upper Jaw; and is of different Colours, *Black*, *Grey*, *Bluish*, &c.—it lies in *Laminae*, or Pieces one upon another, for the most part sixteen or eighteen Feet long.—It is not of a *Bony* Nature, but rather an Opaque Sort of *Horn*, though it may be split so thin as to become quite transparent, like any other Horn.—To cut this *Whalebone* out of the Head is an Employment by itself, and requires many Iron Tools.

Euphros. Pray how is it possible to encounter and subdue such large and formidable Creatures, *Cleonicus*.

Cleon. What is it Man cannot do, my *Euphrosyne*, when assisted by Sagacity, Experience, and all the Mechanical Powers? The *Tower of Babel*, the *Pyramids of Egypt*, the *Corinthian Colossus*, the *Enormous Sphinx*, all shew what Men can do, when once they set about it.—As to taking a *Whale* they make no more of it, than Boys do to catch *Gudgeons*.—In the *Whale Fishery*, Ships are employed of two or three hundred Tons Burthen, with six

of seven Long Boats to each.—These are provided with Cordage, Harpoons, Windlasses, and all other Instruments of Death.—The Harpoon is about six Feet long, and barbed at the End with a sharp Steel Point, and fixed to the Rope about six or seven Fathom long, which is wound about, and runs off from the Capstern at the End of the Boat.—When the Harpooner finds himself at a proper Distance from the Whale, he darts his Harpoon with all his Force against the Back or Side of the Whale, where, if it fastens, the Monster plunges to the Bottom; and the Rope runs off the Capstern very swiftly—if there be not Rope enough in one Boat, they fix it to another in the Boat next to them, and then to another after, if there should be Occasion.—While the Cord is running out, a Person stands wetting it with a Mop or Swab, lest it should take Fire with the great Velocity of its Motion.—When the Whale rises again to take Breath, they attack him again with their Harpoons, and thus renew their Attacks every Time he comes up, till he begins to grow weak with Fatigue and Loss of Blood; and then they plunge their Harpoons or Javelins into his Head and various Parts of his Body; by which Means they soon dispatch him.—Being thus dead, he floats on the Water, and being lashed to the Boat, they begin to cut them up in Pieces about three Feet thick and eight Feet long, which the other Boats carry to the Ship to be stowed up.—These Pieces of Fat Flesh they call *Blubber*.—From which when they come home are made vast Quantities of what is called *Train OIL*.

Euphros. An amazing History, this, of the *Death of a Whale*.—But in the Course thereof, *Cleoniceus*, you intimate that Whales cannot live long without *Breathing the Air*; that should imply they have *Lungs*.

Cleon. They have Lungs, my *Euphrosyne*, and all the other Viscera or Intrails almost, that *Quadrupedes* have; for though all Whales have externally the Form of *Fishes*, yet their Internal Structure is, in a great Measure, conformable to that of *Quadrupedes*.—They engender, breed, and bring forth their Young alive as *Quadrupedes* do;—they have two Breasts and Nipples, and suckle their Young Ones as four footed Animals do.—

Nor

Nor are they Mute, but on the contrary many Sorts of Whales, when they are struck and feel great Pain, make hideous Cries and doleful Shrieks and Noise, that may be heard at the Distance of two or three Miles.

Euphros. Pray, *Cleonicus*, did you ever see the Skeleton of a Whale?

Cleon. I have, my *Euphrosyne*, and of more than one.—I took the Measure of some Parts of a Whale's Skeleton that was fifty-five Feet long.—The upper Jaw-Bone was fourteen Feet long, and about six Feet over.—The Skull on the Inside was four Feet wide.—The Hole for the Passage of the Spinal Marrow was six Inches in Diameter.—One of the large *Vertebra* or Bones of the Spine, was eleven Inches long, and twelve Inches thick.—But for the enormous Size of a Whale's Rib, and consequently of his Body, you may satisfy your Curiosity any Day while you are in Town, by taking a Walk to St. James's Palace, where, in the middle Court, you will see a Rib of a Whale of the largest Size, set upright, and fastened to the Side of the Palace, as a Monumental Specimen of the Wonders of Creating Power.

Euphros. Indeed I shall take your Advice, *Cleonicus*, the first Opportunity that offers.—For no Object at St. James's will gratify my Curiosity so much.—But as you tell me you have many Particulars more respecting Whales to acquaint me with, I desire you not to fatigue yourself any longer at this Time, but reserve it for our next Conference.

DIALOGUE III.

Of the SPERMACETI-WHALE; the wonderful STRUCTURE of its HEAD. The Manner of making SPERMACETI from the BRAIN. Of the Amber-grease WHALES. Of the FIN-FISH; the PORPOISE, and UNICORN FISH,

Cleonicus,

THE SPERMACETI WHALE, my *Euphrosyne*, next offers itself to our View; it is not inferior to the Toothless *Greenland* Whale in Size, but is of a very different Make, especially in the Parts about the Head.—It has a Pipe or Tube in the fore Part of the Head, through which it spouts the Water.—Over the Snout the Fat is two Feet thick, but on the Top of the Head it is only three Inches, and it lies upon a thick Membrane that covers the Brain instead of a Skull.—The Cavity containing the Brain of this Whale is said to be divided into twenty-eight Cells.—I once saw this large Cavity or Pit in the Head of the Whale, and it resembled one of the large Pits in a *Tan Yard*.—The Matter of the Brain was a Liquid, and the Men stood on the Side of the square Pit (about seven or eight Feet long) and drew up the Liquor in Buckets fixed to the End of long Poles, the very same as the *Tanners* use to empty the *Tan Pits*.—I suppose there might be eight or ten Men employed in exhausting this *Spermaceti*, or Liquid Brain of which it is made—while many others were at Work, on several Parts of the Body, in cutting up large Pieces of Blubber, for making Oil, and also *Spermaceti*; though this Drug was formerly obtained only from the Brain of the Whale.

Euphros. What a wonderful Scene then busied the Thought, and ravished the Sight of my inquisitive *Cleonicus*.

Cleon. Such as I never saw before or since.—But the Stench of so huge a Carcase was so offensive, that it abated

abated much of the Pleasure so unusual a Spectacle would have afforded.

Euphros. I wonder how the poor labouring Men are able to endure it.—

Cleon. You know the Adage, my *Euphrosyne*, *no Carrion will kill a Crow*—these Men are constantly employed in such Cadaverous Work—and Use or Custom reconciles us to any thing; it is truly termed a *second Nature*.

Euphros. There seems, indeed, no other Way to account for this, and many other similar Occurrences of Life.—Pray, *Cleonicus*, did you ever see the Skeleton of a Whale of this Kind?

Cleon. Yes; I once did of a young One—the Head of this Sort of Whale is much bigger in regard to it's Body than any other Whale—it has also long, tapering, pointed Teeth in the lower Jaw; which are received into Holes or Sockets of the upper Jaw, just opposite to them—

Euphros. Pray has this Whale any different *Fins* from the former, *Cleonicus*?

Cleon. The most complete Account I can find of the *Spermaceti* Whale, is that which is related by the Fishermen of *Bremen*; viz. That they took one of these Whales in Lat. 77° 30' which was seventy Feet long—it was blackish on the Back and whitish under the Belly.—The Head was of an enormous Size, and of a terrible Aspect; and was nearly half as big as the whole Fish—on the fore Part of the Head it had a single Tube to spout up Water.—The Mouth was not so large as that of a common Whale—but the Throat was wider; for being wounded, it threw up a Fish twelve Feet long—it had fifty-two large sharp Teeth in the lower Jaw, (twenty-six on a Side) all at equal Distances, weighing two Pounds each—In the upper Jaw there were as many Holes, into which the Teeth entered, as into a Sheath—the Eyes were shining, and yellowish, like those of other Whales—the Tongue was pointed, of the Colour of Fire, but small for the Size of the Fish—on the Side of the Head there were two Fins, tho' but small (about eighteen Inches)—on the Top of the Back was a high Bump—and near the Tail another, resembling a Fin.

Euphros. Well, *Cleonicus*, these Accounts are fraught with Wonders!

Cleon. Yes, my *Euphrosyne*, to us, at first Hearing, they seem wonderful; but People concerned in the *Whale-Fishery* are no more affected by this Phænomena, than those in the Fisheries of *Mackarel* and *Pilchards*—but as this Subject is equally strange and novel to you, I shall feed your Avid Curiosity with one Relation more of this Kind, if I am shorter upon other Subjects, more known.—In December, 1723, there were no less than seventeen *Sperma-ceti* Whales thrown upon the Sand-Bank in the Territory of *Hamburg*, of which some were Males and others Females—they were from forty to seventy Feet long; and were all lying on one Side.—The Head above the Eyes resembled a Baker's Oven; and the lower Jaw a little shorter than the upper—in the former were forty-two Teeth, with Holes in the latter to receive them—they were of a Brown Colour—the Blubber was from eight to twelve Feet deep; and while fresh it looked White like Lard. From some Heads they obtained four or five Tons of raw *Spermaceti*.

Euphros. More and more wonderful still! But pray, *Cleonicus*, how do they make this liquid Brain of the *Whale* into *Spermaceti*?

Cleon. The Process is thus, my *Euphrosyne*: They take the Brain, heat and melt it over a gentle Fire, and afterwards pour it into Moulds in the Shape of Sugar-Loaves—when it is cold, and the Oil is run out, they take and melt it again several times, 'till it becomes very pure and White; and then they cut it into thin Slices, in the Form we see it, when brought to us—and that is best which is White, clear, and transparent.

Euphros. Pray, is not this the Substance with which they make those Candles, which go by that Name, and which exceed even Wax Candles in Whiteness?

Cleon. It is so, my *Euphrosyne*; for it is of a very oily and inflammable Nature, and may, like Wax, be formed into Candles, which are much more cleanly than Tallow Candles, and, in many respects, preferable to Wax-Candles; they are much used in public Assemblies, and at Tables of the genteeler Sort of People.

Euphros.

Euphros. I think I have heard much Talk of it as a considerable Medicine, *Cleonicus*?

Cleon. Physicians give it a very great Character as a Medicine, both for internal and external Use; and as a *Balsamic* in one Case, and an excellent *Vulnerary* in the other.

Euphros. Pray what other remarkable *Whales* are there, *Cleonicus*?

Cleon. It is said that there is a *Spermaceti* Whale of *New England*, which produces that odoriferous Drug, we call *Ambergris*, so famous amongst the *Doctors*, and the *Confectioners*; but their Assertion is so lightly authenticated, that I cannot propose it as a proper Article of my *Euphrosyne's Philosophic Creed*.—It is only just worth while to observe that this celebrated Drug, *Ambergris*, has puzzled the greatest Naturalists of every Age to account for it's Origin or Production;—*Animal*, *Vegetable*, and *Mineral* Kingdoms, every Part of Land and Sea, have been tortured and ransacked for this Discovery, but hitherto in vain—and yet if we believe some very reputable Travelers and Voyagers, it is sometimes seen, in incredible Quantities, floating in large Lumps in the Sea.

Euphros. It seems strange to me that so famous a Perfume should remain unexplored in so inquisitive a Century as this has been—but to return to our Subject, I suppose there are many different Species of *Whales* besides those you have mentioned, *Cleonicus*.

Cleon. Nature always delights in variety in her Works of the same Kind; and perhaps in none more than in that of her *WHALE MANUFACTORY*.—Some others remarkable for a wonderful Structure of particular Parts, I shall just commit to my *Euphrosyne's* Memory—one, is a *Whale* called, the *Fin-Fish*, for it's having a large Fin on it's Back, near the Tail—it is as long as a common *Whale*, but three times less in Bulk—it is noted for spouting up Water more violently, and to a greater Height than other *Whales* do—the *Whalebone* hangs from the upper Jaw, but not out of the Mouth, as in other *Whales*—he lays about him with his Tail so terribly when struck, that the Seamen dare not come near him with their Boat—therefore he is seldom taken; and besides he is not so fat as the *Whale*, and on that Score also neglected.—

There

There are many other Whales of a larger Sort, but these I have named are the principal.

Euphros. As you have done with these, how far do you proceed to the lowest Class of Fish that you properly call *Whales*?

Cleon. Through various Species and Orders, still less and less, till we arrive at the PORPOISE, which is least of all the *Cetaceous*, or Whale Kind.

Euphros. I have heard much Talk of these *Porpoises*.—A Lady of my Acquaintance, who has a Country House near the Sea, has the Pleasure often to see Shoals of them pass along the Channel, very near to her Garden, and to amuse herself with the odd Form, and undulating Motion of these extraordinary Creatures, which darken the Surface of the Sea for a great extent, with their *Hog-like* dark Brown Backs.—She has, with great Civility, given me an Invitation to Walk in her Gardens, on Purpose to take a full View of them, which she knows will delight me much—this Favour I intend to embrace very soon.—But pray proceed, *Cleonicus*.

Cleon. I am in no great Haste; we have not much farther to go at this Time—I shall only observe, that the *up-and-down* Motion of this Animal, is on the Account of his *Breathing the Air*, every Time he puts his Head above Water—then he dives down—then comes up again for more Air, and so on, as is the Manner of all Whales; if we could observe them as easily as we do *Porpoises*, we should see them perspire the Air also.—This Fish is very fat, and yields a large Quantity of Oil in proportion to his Bulk, which is sometimes ten or twelve Feet long—they have three Fins, one on each Side the Head, and one on the Back—and also a Horizontal Tail.—They breathe by a large Communication from the Nostrils to the Lungs.

Euphros. Does any thing further remain to be observed of the Whale Kind, that is very material, *Cleonicus*?

Cleon. Only one Thing more, my *Euphrosyne*; and this is too wonderful an Object to be passed in silence; I mean the UNICORN FISH, which is a small Whale found in Seas about *Iceland* and *Greenland*, from sixteen to twenty Feet in Length—It has a long Horn growing out of the
Snout

Snout about eight or ten Feet long, and curiously wreathed or twisted, and tapering to a Point at the End—It is looked upon by the Virtuosi as one of the greatest Curiosities in their Cabinets.—When we take a Walk to *Don Saltero's* at *Chelsea*, you will there see one—for these *Horns* are not so rare as the Fish itself, which is seldom seen.—This Horn was thought formerly to belong to a four-footed Animal, called (for that Reason) an UNICORN—but it is now well known that no such Animal does exist, or ever did, but in Fiction—this is one Proof *that every Age grows wiser and wiser.*

Euphros. But what is that, *Cleonicus*, to what I can boast? For all the World must allow,

*That I, with humble Pride, can truly say,
I feel myself grow wiser every Day.*

DIALOGUE IV.

Of the SAW-FISH; the SWORD-FISH; the BALANCE-FISH; the SHARK-FISH; the SEA-DEVIL; the SUN-FISH; the STAR-GAZER; the FLYING-FISH; the REMORA; the ISINGLASS-FISH.

Cleonicus.

OUR last Interlocution concluded with the *Unicorn Whale-Fish*; and though we now take leave of that Genius of Fishes, we shall find others offer, no less surprising in the amazing Structure and Conformation of the Parts of their Bodies.—The first of these, my *Euphrosyne*, is the SAW-FISH, with a Rostrum, or broad, wide, thin, boney Part, issuing from the fore Part of the Head, to the Length of three, four, or five Feet, according to the Size of the Fish, which is often more than twelve Feet long—this long Bone is almost equally broad to the End—and on each Side it is beset with sharp pointed boney

bony Teeth, not like those of a SAW, but like the Teeth of a large coarse Comb;—these *Denticles* are an Inch and Half long, and about that Distance from each other, in the full-grown Fish—the Back is of an Ash-Colour, and the Belly whitish—there are no Teeth in the Mouth, which is placed transversely under the Head—but the Lips are as rough as a File—there are two Fins on the Back, and four on the Belly—the Eyes are placed high on it's Head, just over the Mouth.—Some Naturalist affirm, this singular Fish does sometimes grow to the Length of twenty Feet.

Euphros. A surprising Fish, indeed! Pray, *Cleonicus*, can you guess what may be the Design of Nature in furnishing this Fish with such a tremendous Weapon?

Cleon. I suppose it is designed both for Attack and Defence.—This all agree in, that the *Saw-Fish* is a great Enemy to the *Whale* and *Fin-Fish*—for a great many *Saw-Fish* will attack a *Whale* at once with their Saws, which cut their Way into, and out of his Body, and will never desist 'till they have killed him—tho' when they have done this, they eat only his Tongue, (as we are told by Fishermen) and leave the whole Carcase behind—these are all the Particulars of Note in this extraordinary Fish;—And now, my *Euphrosyne*, after all, do you know what this is?

Euphros. Dear *Cleonicus*, where did you get this pretty little *Saw*? It tallies exactly with the Idea you have delineated of it in my Mind.—How delicate and yet how grand a Specimen of Nature's Workmanship is this!—I think you will enrich me with all the Treasures of the Creation, e'er long.

Cleon. You can't be too rich in *natural Science*, and that is best taught by Nature herself.—But now, my *Euphrosyne*, another Phenomena of a similar Nature presents itself to our Contemplation.

Euphros. Pray what is that, *Cleonicus*?

Cleon. The *SWORD-FISH*, my *Euphrosyne*.—This is not the same Species with the *Saw-Fish*—but this carries a *SWORD* before it's Head, as that does a *SAW*—but the saw grows from the Head, or Skull of the Fish, and is in a horizontal Position, whereas the *Sword-Fish* has a Head
and

and Mouth like common Fish, and the *Sword* is only a Continuation, as it were, of the upper Jaw or Snout of the Fish.—This terrible Fish is as big as a small Whale, being fifteen Feet long.—The Body long and round, and tapering towards the Tail—covered with smooth but thin Skin.—The Head very thick and large—and the Tail forked, or curved like the New-Moon.—It has two Fins on the lower Part of its Body, and on its Back, almost the whole Length; it has a Pair of large Fins also at the Gills.—This *two Edged Sword* is five Feet long at least in large Fishes.—The *Sword-Fish* is plentifully found in the Seas between *Italy* and *Sicily*, and are caught by *Harponiers* in the same manner as Whales.—The Flesh is very white, and preferred to *Sturgeon* by the People of *Messina*.—This *Sword-Fish* was the *XIPHIAS* of the Ancients.—I have no *Sword* of this Sort to present you with, but you will see one shortly at *Don Saltero's Coffee-House*.

Euphros. That will suffice for me, *Cleonicus*; Women have nothing to do with Swords.—

Cleon. Don't mistake yourself, my *Euphrosyne*; these *natural Swords* become *Women* much better than artificial Swords do *Men*.—You draw these *natural Swords* against Ignorance and Superstition, and consequently, in Defence of *true Religion*; whereas *Swords of Steel* are too often sheathed in the Bowels of Friends and Hero's, by the *sanguinary Sons of Mars*.

Euphros. Well, after all, the *Sword* has a dreadful Sound.—What other Fish comes next on the *Tapis*, *Cleonicus*?

Cleon. I think to present you next with a short Account of the *BALANCE-FISH*, which for it's Structure, is the most extraordinary Fish in the World, having a *long Head* placed cross-wise to its Body, or like the *Head of a Hammer* with large Eyes standing out at each End.—It is of a most odd and peculiar Aspect—its Size is five or six Feet, and sometimes much longer.—It is covered with a Skin without *Scales*, *Hair*, &c.—and is of the *Shark-Kind*, having a transverse Mouth as well as Head, with three or four Rows of Serrated Sharp Teeth, placed under the middle Part of the Head.—It has pectoral and other
Fins—

Fins—and those of the Tail, are of very unequal Lengths.—It is a Native of the *Mediterranean Sea*.

Euphros. This is a strange Sort of Fish, sure enough!—I never heard of a Hammer-Headed Fish before.—But the COMMON SHARK I have often heard talk of as a terrible voracious Creature; did you ever see One, *Cleonicus*?

Cleon. I never saw One alive, my *Euphrosyne*, but I have seen the most notorious Part of it, and that is, his tremendous Head and Jaws, which strike Horror into every One that views them, on Account of their largeness, and the Rows of serrated broad Teeth in each, horrible to behold.—What the Poet says of the *Leviathan*, is literally true of the *Shark*.

*Whose Heart sustains him to draw near? Behold,
Destruction yawns; his spacious Jaws unfold,
And, marshal'd round the wide Expanse, disclose
Teeth edg'd with Death, and crowding Rows on Rows.
What hideous Fangs on either Side arise!
And what a deep Abyss between them lies!*

And to shew you, my *Euphrosyne*, that there is as much Truth as Poetry in this Description, you need only cast your Eyes on the most shocking Spectacle of this kind you ever saw.—There it is.

Euphros. Dear me, *Cleonicus*, I am almost afraid to come near it though dead—how large, how wide the Mouth! What Rows of Teeth crowding upon each other, one behind another are there all around each monstrous Jaw.—Well, I never saw so enormous a Jaw Bone before.—It must surely belong to a Fish of a very large Size, *Cleonicus*,

Cleon. A *White Shark* full grown is about Eighteen Feet long; and weighs upwards of a Thousand Pounds.—It is covered with a rough Skin—It has several Fins, large and small.—The Head is depressed—The Mouth placed transversely under the Head as in the Saw-Fish, Balance Fish, and all others of the Shark kind—They are found in all Parts of the Ocean—And follow Ships for a long way together, in expectation of Prey, as People falling over Board, dead Bodies, Offal Meat, &c.—

&c.—They make nothing to bite off a Man's Leg, or Arm, when they can lay hold of them.—They are supposed to have from One Hundred and Fifty to Two Hundred of those terrible Teeth in their Merciless Jaws—And Throats wide enough to swallow a Man alive—The Sailors take them by striking them with a barbed Iron called a *Fixgig*—or else by baiting a Hook fastened to a strong Rope with a Piece of Salt Beef, which he voraciously swallows; and then they drag him on Board.—I shall only observe to you further, that the Teeth are all of them set in a strong Muscular Substance like *Thong*, by which they are all at once *raised up right*, or *laid down flat* in the Mouth, at the Pleasure of the Fish—This you may now perceive though it be hard and dry, and can scarce be cut with a Knife—One of these Ivory Teeth will make a very fine Object for your *Opake Solar Megaloscope* at any Time.

Euphros. I can hardly find Room in my *Museum* for so large a Present; but it is a *capital Phenomenon*, and I'll keep it as long as I live for your Sake, *Cleonicus*.

Cleon. Well, now for some other subject, what do you think of a SEA-DEVIL, my *Euphrosyne*?

Euphros. Why even a *Sea-Devil* may possibly be more dangerous than any other—For I suppose, under this odd Character, you mean some frightful shocking form of a Fish, *Cleonicus*.

Cleon. I do, my *Euphrosyne*; the DEVIL-FISH, properly so called, is about the size of a Shark, but some under this description are said to be much larger, and others much less; in short, very few Writers on this Subject, seem to know any thing of this Fish—I never met with more than One Person who had ever seen One; and he, never but once in Forty Years that he had been a *Diver*—He told me, it appeared to be about Eighteen Feet long, that it had Two short Horns upon its Head like those of Welch Runts, cooping inwards; that it had large Eyes, and a horrible Appearance in every Respect—As soon as he saw it, he rang the Bell, and was instantly drawn up by the Ship, to escape being devoured by it.

Euphros.

Euphros. What Peculiarity in the Fabric of Fishes do you next observe, *Cleonicus*?

Cleon. Something in the SUN-FISH that really appears a little comical; for it looks like a Fish with *half a Body only*; what Body it has is indeed large, as it weighs upwards of One Hundred Pounds; though its Length is not more than Two Feet—Its Mouth is small in proportion to its Body—but the Jaws are hard, rough, and sharp; and seem armed with Rows of sharp Teeth.—It has no Scales, but is covered with a hard thick Skin—There are two small Fins just behind the Eyes; and two large ones at the hinder Part, one on the Back and the other on the Belly—A circular Fin surrounds the hind Part (for Tail it has none) near which is a broad Stripe, which makes it look as if bound with a fillet—But you will have a much better Idea of this queer Fish by viewing one at *Don Saltero's*—At the same Time you will see the Reason why it is called the SUN-FISH—There is also a Fish, called the MOON-FISH, of which hereafter—But the STAR-GAZER we must stop at; and pay our Tribute of *Wonder*.

Euphros. Now you talk of that, *Cleonicus*, I don't know any Sort of Creatures are better fitted for Star-gazing than Fish; for the Heaven would be always exposed to their View, if they had Eyes on the top of their Heads.

Cleon. Why you have just hit off the Fish, my *Euphrosyne*; it really has it's Eyes upon the *Top of it's Head*; and its View is directly upright, or in the *Zenith*—The Eyes are large and stand near each other, and the Iris of a Gold-Yellow—The lower Lip is fringed with Barbs—It is at full Growth about a Foot long—and is an Inhabitant of the *Mediterranean Sea*—and though this Fish is so great a Singularity, the next I shall mention, you may, perhaps, think more so, which is the FLYING-FISH.

Euphros. To be sure it is a strange Phænomenon to see a Fish fly; but I think a *Flying-Quadrupede* is full as strange, *Cleonicus*, for I can rather more easily conceive Wings may be made out of Fins, than the Legs of a Mouse or Squirrel.

Cleon. And that is indeed the Case, as you see in this

his, which I desire your Acceptance of, to put along with your *Bat* in the *Museum*; but my *Euphrosyne* will pity the hard Fate of this poor *Fish*, which, while it is pursued in its own Element, flies from its Enemies there into the Air, where it soon becomes the Prey of some voracious Bird; if it escapes, it will keep flying as long as the Fins are wet; and then drops into the Sea again.

Euphros. I thank you for so distinguished a Present, *Cleonicus*; and pray what other *Peculiarity* do you observe in *Fishes*?

Cleon. There is one deserves Notice, for it's odd Faculty of *sticking very fast* to the Keel and Sides of a Ships and Vessels under Sail, and thereby retarding their Motion, whence the Ancients called it the *Remora*, but we the SUCKING FISH—The SUCKER (of a most wonderful Structure) is fixed on the top of its Head—the Body about Eighteen Inches long, and Three or Four Inches thick, and almost round—with Fins, Tail, &c. like other *Fish*.—There is only One *Fish* more, of the common sort, that I shall mention as deserving particular Notice, on Account of its affording that useful Commodity we call *Isinglass*, made of some Parts of its Entrails called *Sounds*; and therefore the Animal is called the ISINGLASS FISH.——It is very large, some say, Eighteen or Twenty Feet long—It is covered with Scales, broad as a half Crown—It has many *Fins*; but nothing externally remarkable above other *Fish*.

Euphros. I think you have descanted on the Subject of wonderful *Fishes* a long Time, *Cleonicus*.——It is time you had a little Respite.

Cleon. I am not tired, but as we shall at our next Meeting take a View of another Species of *Fish*, I shall only observe for the Present, that there is nothing of great Singularity in the *Dolphin*, the *Sturgeon*, *Salmon*, *Cod*, *Carp*, *Tench*, *Trout*, *Mulletts*, *Mackerel*, *Herrings*, *Pilchards*, *Pike*, *Perch*, *Smelts*, *Gudgeons*, &c. &c. but that they afford you many sumptuous and delicious Dishes for the Table, when they are severally in Season.—The common *River-Fish* are thus beautifully Characterised by *Pope* in his *Windfor Forrest*.

*Our plenteous Streams a various Race supply,
Of bright Eyed-PERCH with Fins of Tyrian Dye,
The Silver EEL, in shining Volumes rool'd,
The Yellow CARP with Scales bedrop'd with Gold,
Swift TROUTS diversified with Crimson Stain,
And PIKES, the Tyrants of the Wat'ry Plain.*

DIALOGUE V.

Of FLAT-FISH in General. Of RAYS, SKAITES,
THORNBACK, &c. Of the TORPEDO, or CRAMP-
FISH, TURBOTS, SOLES, PLAICE and FLOUN-
DERS.

Cleonicus.

THE Species of Fish, which are propos'd for the Subject of our present Reflections are what are commonly called FLAT FISH, and by the Naturalists, *Cartilaginous Fish*—with the generality of these Fish my *Euphrosyne* is too well acquainted to need much description.

Euphros. I know but little more of *Fat Fish* than what I have observed of them while they lie on the Fish-Monger's stall, or in the Hands of our Cook—This most People know, that they are *very good Eating*.

Cleon. In what an infinity of Forms does Nature dress out her Fishes for our inspection! almost all other Animals, *Quadrupeds*, *Birds*, and *Insects*, have three Dimensions, *Length*, *Breadth*, and *Thicknes*s; but these seem to be squeezed into two Dimensions, of *Length* and *Breadth* only—The *Thicknes*s, being inconsiderable in comparison of the other.

Euphros. They really have a different Aspect from any other Fish—they look more like *half Fish* than *Whole Ones*—Their *Backs* and *Bellies* are their *two Side*, which can be said of no other Fish.—The singular Shape and Complexion of this *Order of Fishes*, I have always regarded
with

with admiration—in short, *Cleonicus*, I almost think it dissimilar to its self.

Cleon. The *Bones* are, in most Animals, the support of the Fabric of Muscular Flesh, which makes the Body, and these give also Strength and Power of Exertion—But to shew that Omniscience is not confined to any *general Rule*, instead of Bones we find many sorts of Fish constructed with CARTILAGES or GRISTLES; and yet have prodigious Force and Strength in their several Parts; witness the *Sharke*, the Balance Fish, and many others—From this consideration too, it appears that these Cartilaginous Fish grow larger as they grow older; their Cartilages never acquiring such a Degree of hardness and Size, as to limit their future growth.—These Cartilaginous Fish are a sort of middle Nature, between the Cetaceous, or Whale kind, and the common sort of Fish, for they breath through Gills like the latter, and bring forth their Young alive, like the former.—Also some are covered with *Skin*, and others with Scales.

Euphros. I suppose by what you intimated, that *Flat-Fish* also are distinguished by all these varieties and differences—I further suppose that of Flat-Fish there are different sorts or orders—Pray, *Cleonicus*, which are the Principal, or most noted for their Size?

Cleon. These are of the Cartilaginous kind, and have Bodies of an Angular Figure, some in form of a *Triangular Surface*, some of a *Square*—many of them are broader than they are long.—The Extreme Parts or Edges are all fringed round with a kind of grizzly mucilaginous Fin from Head to Tail.—The Mouth is on the under or Belly Side, and placed *transversely*, as in the *Shark*—The Eyes just over it, on the upper Side, or Back—And what is very singular, they have all a *slender, long round Tail*, armed with Spines, Hooks, and other Weapons, for *taking their Prey*, and *Defence* against Enemies—Some of those Spines or Stings in their Tails are venomous, which render them very formidable to the Fishermen—The Poisonous sort abound chiefly in the Mediterranean Sea, and are known at *Rome*, and *Naples*—We call them *Fire-Flaires*, *Sea-Eagles*, *Rays*, &c.—But those of the innocent sort, and are found

every where, you call SKATES, THORNBACKS, MAIDS, &c. with which you are as well (if not better) acquainted than myself.

Euphros. Pray how large a Size do *Skates* grow to, *Cleonicus*?

Cleon. I don't certainly know how large, but it is upon Record, that a Fishmonger at *Cambridge* sold one to *St. John's College*, which weighed two Hundred Pounds, and dined one Hundred and twenty People——The Length was forty-two Inches, and the Breadth thirty one——The form and all other Properties of the *Thornback*, are so nearly allied to that of the *Ray* or *Skate*, that they merit no farther Notice.——But there is one particular Fish of this Order, that highly deserves your most serious Attention, as it directly points out the Finger of God in creating it.

Euphros. I long to hear you say *Cleonicus*, what this extraordinary Fish may be.

Cleon. It was called by the Ancients TORPEDO, and by the Moderns the NUMB-FISH, from the wonderful Power it has of *torpifying* or *benumbing* the Hand or any other Part that touches it, and that to such a Degree as to produce Sensations like the *Cramp*, and for that reason it is also called the *Cramp-Fish*.

Euphros. Amazing indeed! I should think by what you say, *Cleonicus*, that this wonderful Power of the Fish, was of the *Electrical* kind, or that it is properly an *Animal* ELECTRICITY.

Cleon. I do not know that it will *attract light Bodies*, but this is certain, that the Shock is *instantaneous*, like that from the *Leyden Bottle*, or charged *Viol*; but the Effect remains longer, and sometimes attended with great Pain——Those who have tried the Experiment say, that as soon as the Hand touches the Fish, it strikes a *tingling* into the Hand, Arm, and Shoulder; attended with a *trembling*, and a very accute Pain in the *Elbow*——and that the same painful Sensations are renewed as often as the Trial is repeated.——But that they grew weaker and weaker, till the Creature dies, which will happen in about three hours Time——After it is dead, this Quality is lost, and the Fish may be handled as safely as any other

other—The celebrated *Reaumur* observes (at least thought) that the stupifying Quality consisted in the *Velocity of the Parts* which strike, for the Person affected imagines his Finger receives a *violent Stroke*.

Euphros. Pray, *Cleonicus*, do any of your *learned Naturalists* pretend to account for this wonderful *Stupifactive Quality* in this Fish?

Cleon. They pretend to it my *Euphrosyne*; they say, it is owing to the *Mechanical Structure* and action of the *peculiar Muscles* of this Fish, that it is able to produce such an amazing Effect—But after all they have to say, they leave you as much in the Dark as before—There is annually a *new Theory of Muscular Motion* at *Gresham College*—Indeed it would be just as modest in our sages to tell us *how the Fish is made*, as to account for any divine or Miraculous Power we find it possessed of—For my own part, I am content to know that such Powers do exist, and to observe the effects they produce—As to any thing further, I am not ashamed to add, *I ne scai quoi*.

Euphros. I commend you, *Cleonicus*, for acknowledging your ignorance of things above the reach of the *Human understanding*—I shall greatly delight to hear you expatiate on facts and truth; but opinions and conjectures in Philosophy, or any Science, will make me but little the wiser.

Cleon. I am glad to find you so well disposed for rational Contemplation.—We shall by and by have another similar Instance of *Animal Electricity*.—But in the mean Time, as I suppose you have never seen the *Torpedo*, I must inform my *Euphrosyne*, that it is not much bigger than a large *Plaice*, and of a round Form almost—and that they are found in great Plenty on some Parts of the *Coast of France*; to the frequent Annoyance of Fishermen, and the Entertainment of *Connoisseurs*.

Euphros. Please to tell me what Class of Flat-Fish do *Turbots*, *Soles*, *Plaice*, and *Flounders* belong to; for I observe *Cleonicus*, there is a great Difference between these and the *Ray-Kind*.

Cleon. They are quite another Genus, that is, they are of the *Oviparous Kind*, or such as produce their Young from Eggs,

Eggs, or what we usually call *Spawn*, as most other Fish do.—Also they have real *Bones*; A Spine, with *Vertebrae*, and Ribs, like other Fish.—Their Fins indeed surround the Body from Head to Tail, but they are constructed with Bones also.—The Head is formed with Gills, and placed in the usual Manner.—As also the Mouth, but one Half is in the Right Side, and the other Half in the Left.—The Eyes are placed both *on one Side*, or Back of the Fish.—The Tail is a Fin, and formed and placed, as in the generality of other Fish.

Euphros. You have very accurately enumerated the many Oddities and Peculiarities in this Sort of Flat-Fish; but there is one Difference more which *Cleonicus* has not yet mentioned; and which makes the *Halibut*, *Turbot*, and *Sole* a distinct Species from the *Plaice* and *Flounder*.

Cleon. Indeed, my *Euphrosyne*, pray what is that?

Euphros. It is this *Cleonicus*, that in the *Turbot*, *Plaice*, and *Flounders* the right Side is the Back, but you observe the contrary in the *Sole* and *Pearl Fish*.

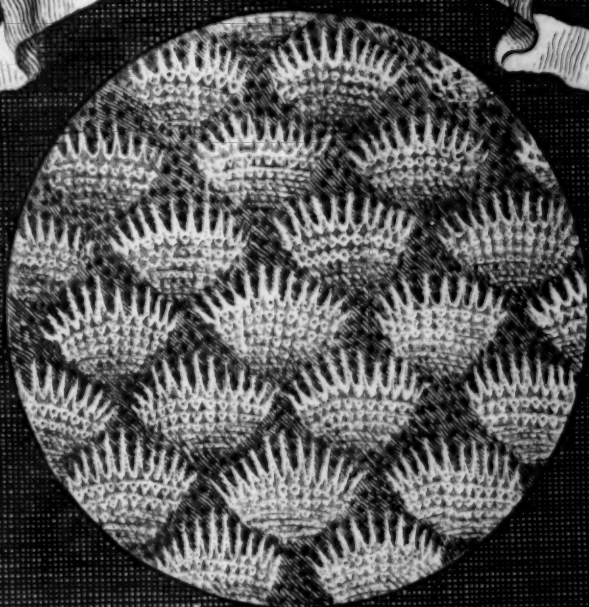
Cleon. You have corrected me, indeed, my *Euphrosyne*—that was a Circumstance I did not advert to—but on Recollection, I know it is Fact, and a very material Distinction.

Euphros. Now we are on the Subject of *Soles*, *Cleonicus*, I must tell you that I have spent many happy Hours in the Use of those Microscopes you gave me some time ago, and particularly in viewing some small Pieces of the Skin of this Fish in the *Opake single Microscope*.

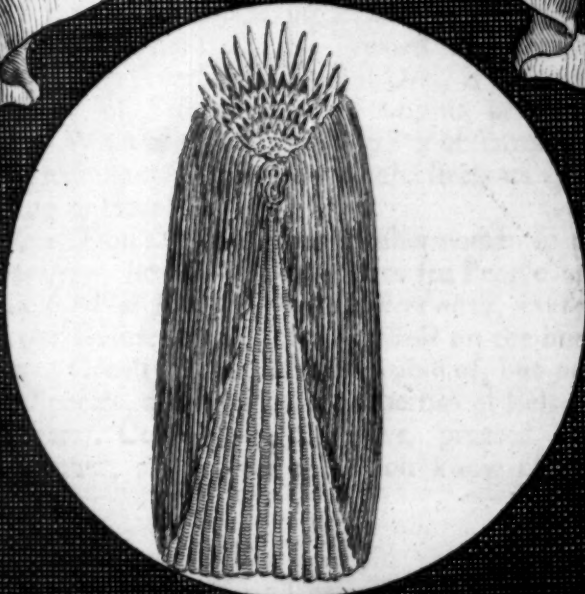
Cleon. I have since that Time contrived another Method of magnifying Opake Objects in the *Dark Room*, in what I call an *Opake Solar Microscope*, which gives a new and most delightful View of all such Sort of Objects; as well as affording an easy Way of delineating any of them at Pleasure.—One of these I now make my *Euphrosyne* a Present of, as an Addition to her *Optical Apparatus*.

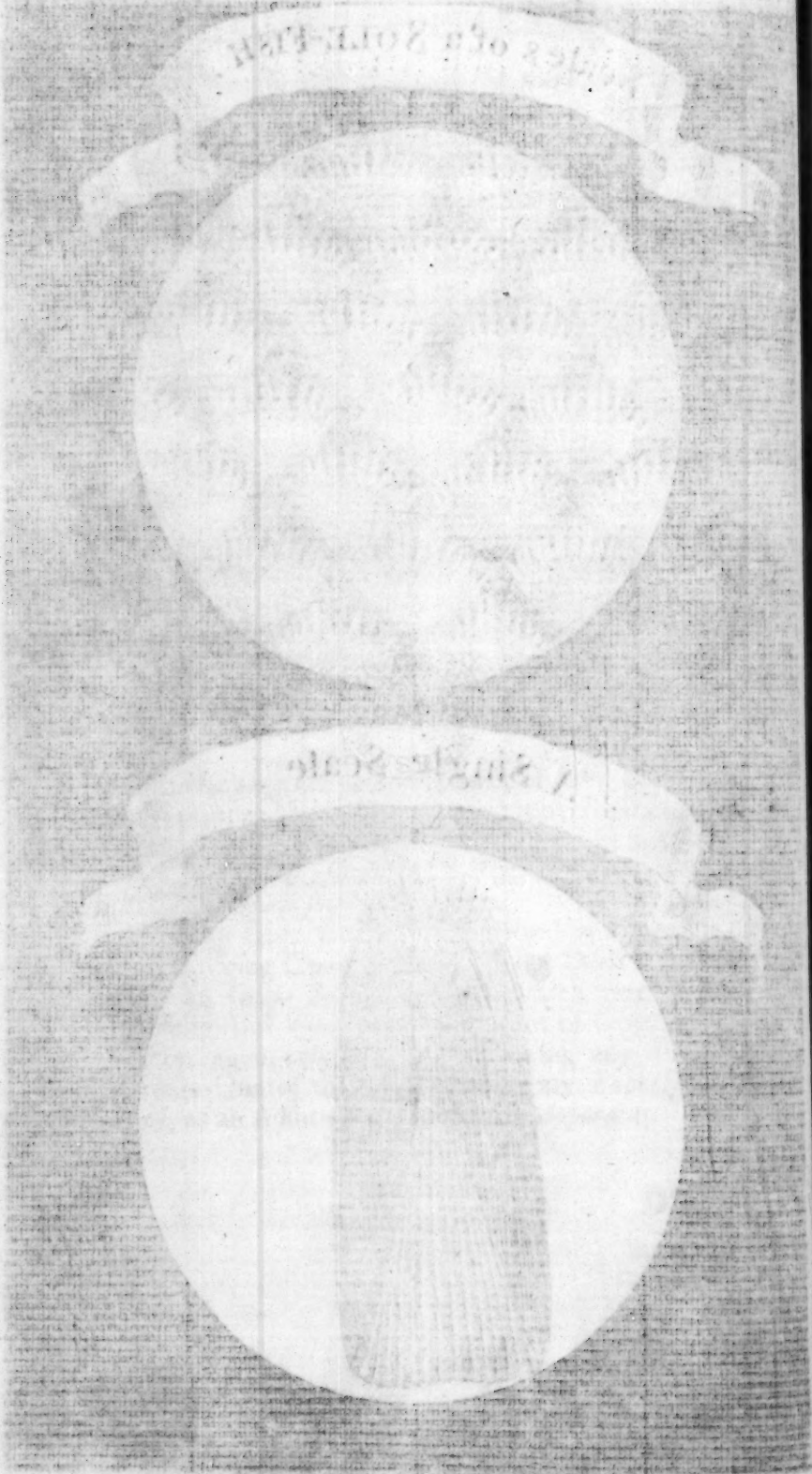
D I A.

Scales of a SOLE-FISH.



A Single Scale





DIALOGUE VI.

Of EELS in general. Of CONGER EELS, and EEL-VERS. Of the LAMPREY. Of EELS with two FEET. Of the ELECTRICAL FEL from SURINAM. Of WATER-SERPENTS, SEA-MONSTERS, MERMEN, MERMAIDS, &c

Cleonicus.

WE are now arrived in our *Survey of Fishes*, to that Species, commonly called EELS; and here my *Euphrosyne* will find fresh Matter for Wonder and Amazement.—You are full well acquainted with the Form and Make of an Eel—and that its Motion, as well as its Form, is of the *Serpentine* kind—that an Eel is, in short, nothing but a Sort of *Water Serpent*.—How Eels are produced is yet a Point of *Natural History* undetermined; that is, whether they are *brought forth alive*, or generated from *Spawn*, which may seem very wonderful in a Subject so common.

Euphros. I can assure you, *Cleonicus*, the Eel has so much of the Appearance of the Viper or Serpent, that though I know it to be a delicious Dish, I scarce ever eat of it, without conceiting I am eating a Serpent, to which I have naturally the greatest Antipathy.—What encreases my Aversion to an Eel Diet, is the unparalleled Barbarity of Fisherwomen in striping or slaying them alive.—What cannot Custom do! it obscures our Reason by degrees, hardens our Hearts, and steels us against every Feeling of Humanity itself.

Cleon. Don't blame the old Fisherwomen so much, my *Euphrosyne*; how common is it to see People of the first Rank fry Flat Fish, and boil Lobsters alive, every Day?—But our Business now is not to reflect on the horrible Degrees of Cruelty Mankind are capable of, but on the Nature, Species, and wonderful Properties of Eels.

Euphros. Come then, *Cleonicus*, proceed in a regular Manner, and tell me what you know of the Size of Eels.

M 4

Cleon.

Cleon. The largest Species of Eels is the CONGER EEL, or *Sea-Eel*, it is several Yards long, and five or six Inches thick—but the smallest Size are those called ELVERS, of two or three Inches long; which abound in the *Severn* to an amazing Degree, and the People at *Gloucester*, and other Places fry them into *Pan-Cakes* with a little Flour, and then with a little Butter, Pepper, &c. eat them as a great Dainty.—There is another anomalous kind of Eel called a LAMPREY or LAMPERN, that is often of a great Size, five or six Feet long, and the Body and the Head more than six Inches round—there are seven Holes on each Side the Head, under the Skin; here the Gills are concealed:—The Mouth is large and furnished with Teeth.—It has no Bones but a *Gristle* along it's Back.—These *Lampreys* are Fresh-Water Fish, and found in many Rivers in England.—But there is also a *Sea-Lamprey* of a larger Size, viz. eight or nine Feet long, and twelve Inches round at the Head.—In all other respects like a Lampern.—There are found in other Parts a great many other Varieties of this Sort of Fish, and are in general called *Sea-Serpents*.

Euphros. Pray *Cleonicus*, how do you account for Eels coming into a Pond where none had ever been put? for a Farmer once assured me that he found Plenty of Eels in a Pond that he had but newly made, and was certain none had been put into it.

Cleon. They have a surprizing Kind of Instinct in migrating from Pond to Pond, from Brook to Brook, and from one muddy Ditch to another, through the Grass of the Meadows between, as has been observed by several Persons—and that not only in quest of better Habitations, but likewise to catch Snails, &c. in Grass.—In a very hard Frost, they have been found frozen to Death in the Meadows.—An Eel will live so long out of Water, that it seems to be almost an *Amphibious* Animal—It is not an easy thing to deprive a EEL of Life; for after the Throat is cut, the Skin flayed off, and the Entrails taken out, there will remain the Symptoms of Life and Animal Motion for a long time, much like what is observed in a *Viper*, and all the Serpent-kind.

Euphros. These are wonderful Properties of Eels that
you

you have related ; pray, *Cleonicus* have you any thing further observable in them ?

Cleon. Yes, my *Euphrosyne* I have ; and very much so too.—For some *Eels* have FEET, that is, they are *Bipedes*, or have *two* Feet on the fore Part of the Body near the Head.—They are very much like the Fore-Feet of a large Lizzard, as near as I remember, but somewhat longer.—It was brought from *America*, where undoubtedly they are plenty, though I never saw or heard of more than that One I speak of.—The Size of it might be about fourteen or fifteen Inches in Length, about an Inch and Quarter thick, and very much resembled a common Silver-bellied Eel in all other Respects.

Euphros. So great a *Novelty and Singularity* in the Form of so common an Animal, must be, in the highest Degree, a most pleasurable Sight to my dear *Cleonicus*—After all you have hitherto said of Eels, am I to expect to hear any thing more of the *Wonderful* in them ?

Cleon. The very *Wonder of all Wonders* is still behind, my *Euphrosyne* ; the EEL is the only Instance Nature affords of *Genuine Animal ELECTRICITY*.—But this Eel is a Native of *Surinam* in *Guiana*, a Province of *South America*, near the Equinoctial Line.—This Eel has a much better Right to the Epithet of an *Electrical EEL*, than the *Torpedo* has to that of an *Electrical Fish*—For this Eel is so perfectly an Electrical One, that it has the Power of striking, or giving the Shock, in a Manner so like the charged Vial, that it cannot be distinguished from it by those who have tried the Experiment often.—And this not only by immediately touching the Eel itself, but even by Means of a *Conductor*, as the Water in which it swims, the Vessel in which it lies, the Stick or Cane wherewith you touch it ; in all Cases the Shock is given in the same Manner as by a Conductor from the *Leyden Bottle*.—But it has never yet been known, that the Power of the Cramp-Fish is or can be communicated by any intermediate Conductor, or any otherways than by immediate Contact.—And then, as to the Effect or Duration thereof, that of the Eel is the same as from the Bottle, and goes off as suddenly, shocks the Elbow after the same innocent Manner as Electricity does, and not with that disagreeable, painful,

painful, and lasting Stroke, as you Experience from the *Torpedo*.

Euphros. Whilst I live I never expect to see an End to the Wonders of Nature; Pray, *Cleonicus*, how long has this *Discovery* of an *Electrical Eel* been made?

Cleon. But a few Years ago, I cannot exactly tell how many, nor who was the first Discoverer thereof; these Things are generally obscure in their Origin, but like *Sparks* of *Electrical Fire*, they soon blaze out and strike with Amazement every Beholder.

Euphros. Now you talk of *Sparks* of *Electrical Fire*, *Cleonicus*, Pray has any such *Sparks* of Fire been emitted from the Eel?

Cleon. In the Accounts I have read and heard of it, I don't remember any such Phænomenon having been certainly observed.—I know it has been affirmed by some, and denied by others.—There has been One brought over to *England*, and shewn in this City; but being out of Town during that Time, I had the Mortification to loose the Sight of it.—I suppose, my *Euphrosyne*, there will soon be more brought over; for the *Virtuosi* here will be impatient to be fully instructed in the *New Doctrine* of *Animal Electricity*, though they do not yet understand the *Old Sort*.

Euphros. Why then, I suppose, *Cleonicus*, we must look upon this *Eel* as a *New Kind* of *Condenser* of *Electricity*; and that there is but one *Sort* of *Electrical Fluid* all the While, which is collected, condensed, and emitted with Force from the *Leyden Vial* in one Case, and from the *Body* of the *Eel* in the other.

Cleon. I could not so well have made the Comparison myself, as my *Euphrosyne* has done it for me.—And why may not the peculiar *Skin* of this *Eel* be considered as a *Non-Electric* as well as the *Glass Vial* itself?—and the *Flesh* and *Entrails* of the *Eel* which fill it, to answer the same Purpose of *Water*, *Mercury*, *Brass Filings*, &c. in the said *Vial*, that is, for collecting, retaining, and condensing the *Fluid*, and thereby to have it in its Power at any time of producing the *Stroke*.—But enough of *Conjecture*.

Euphros,

Euphros. I suppose the final Design of communicating those miraculous Powers to the FISH and the EEL, was Self-Defence; don't you think so, *Cleonicus*?

Cleon. Yes I do, my *Euphrosyne*; I don't know any thing more amazing than the Variety of Methods which Nature has imparted to Animals for their Means of Preservation from the Attacks of their Enemies.—What Armour, what Mail, what Spines, Stings, Stenches, Talons, Beaks, Horns, Swords, Saws, feigned Death, Contortions of the Body, invisible Powers, delusive Cunning, &c. and all to wound, terrify, deceive, and defeat their Pursuers, and to frustrate their Attempts to destroy them.

Euphros. There is certainly nothing in which a Divine Providence is more conspicuous!—But pray, *Cleonicus*, after what Manner do Eels and Water Serpents live?

Cleon. Some by seizing upon their Prey as it were by stealth.—Others of the direct *Serpent-Kind*, by darting suddenly upon it; and though it be an Animal much thicker than their own Bodies, yet have they so strange a Faculty that having laid hold of any Part, they will suck it in by imperceptible Degrees, and be near Half an Hour in the dreadful Operation;—I say *dreadful*, as it surely is to the poor Creature so devoured.—I was once a Witness to this Tragical Scene; being *Angling* by the Side of a Brook, my Ears were assailed gradually by some poor Creature in Distress, with the most dismal, dreadful, and lamentable Screams and Cries I ever yet heard.—I was greatly affected with the long Continuance of these Melancholy Notes and Cries; and ran this Way and that, by the Side of the Brook, to find out what, and where it was.—At last I discovered under an old over-hanging Alder, a large *Serpent* sucking a full grown *Frog* into his Mouth—and though the Noise had already continued long and loud, no more than one hind Leg and Thigh, was yet drawn into the Jaws of the Snake.—I then gave him a Smatch with my Rod, which made him let go the Frog and swim off precipitantly for his own Safety.

Euphros. A miserable Method this to satisfy Hunger, as one would think, both to the Snake and the Frog.—But I would think nothing amiss in the Works of Nature.—Mr. Pope says, *Whatever is, is right.*—And that

Ev'n

*Ev'n Discord's Harmony, if understood;
And Partial Evil, Universal Good.*

Cleon. Let us now change the Scene, my *Euphrosyne*, from the *Melancholy* to the *Monstrous*, I mean, to some Reflections on the Monsters of the Ocean.—And here we shall have Recourse again to the Right Reverend Historian, PONTOPIDON, who tells a Story of a *Sea-Monster* or *Serpent*, more than a hundred Yards in Length, which he once looked upon as a *Chimera*; but says he, “I am now fully convinced they are found in the *North-Seas*.—The Head of this huge Snake is said to resemble that of a *Horse*.—The Mouth black, and very large—with Black Eyes—and a *White Mane* hanging down from its Neck to the Surface of the Water—between the Head and Body were seven or eight Folds.—They have been seen to raise themselves out of the Water to an astonishing Height—and sometimes to spout the Water out of their Nostrils like the Whale.—Wherever it goes it puts the Water in great Agitation—and sometimes oversets Boats and Vessels by flinging themselves across them.—To row from them is impracticable, but the Fishermen have Methods to avoid their Pursuits.—Their Scent is extremely quick—have a great Aversion to *Caster*, for which Reason the Fishermen, and other Mariners, provide this Drug to carry to Sea with them.”—This and many other strange Accounts, the Bishop declares were attested to him upon Oaths of very creditable People who used the Seas about Norway, Lapland, &c.

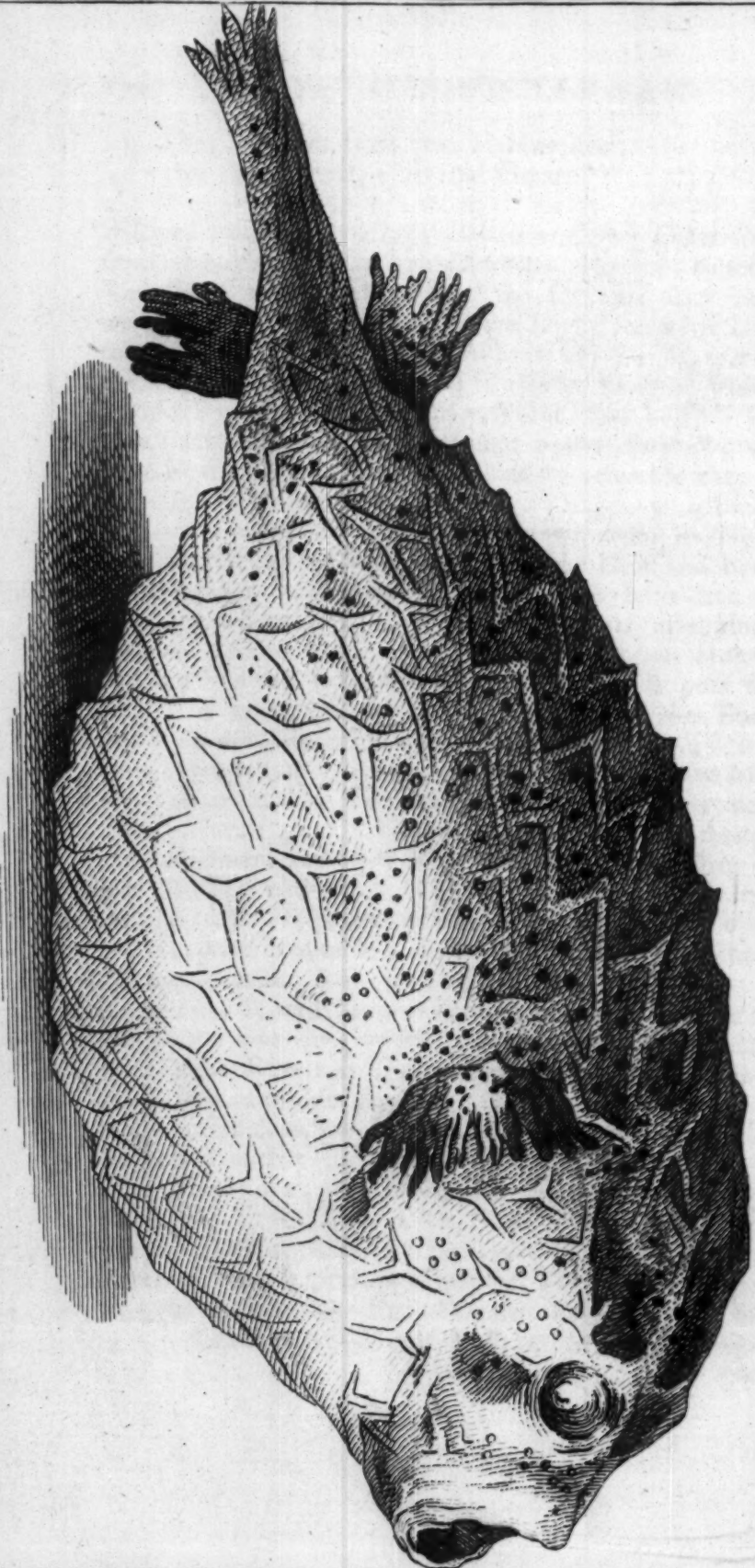
Euphros. It will be time enough for me to believe all this, when you do yourself, *Cleonicus*.—But pray, does this Right Reverend Gentleman say any thing about *Mere-Men*, and *Mer Maids*.

Cleon. He does, my *Euphrosyne*, and says they are called *Sea-Apes*—that they are from three to four feet long—The Head oval, and Face like human—with high Forehead, little Eyes, a flat Nose, and large Mouth; but no Chin or Ears—It has something like two short Arms without Joints, and Hands or Paws, and four long Fingers to each.—The Females have Breasts, and suckle their Young—Their Flesh is generally esteemed good

THE FORD FISH DOWN FROM THE PLATE



~ The TOAD FISH drawn from the LIFE. ~



good Eating—When they are taken, they make a lamentable Noise—The Bishop further observes, that the *Sea-Horse* is sometimes seen in their Seas, but not so common as about *Iceland*—If we believe other creditable Authors, there are *Sea-Cows*, *Sea-Wolves*, *Sea-Lions*, &c.—In short, we find almost all the *Land Animals* in the *Sea*, and *Great Rivers*; with some Deviation towards the Fishy Nature and form in some particular Parts—But most of these we must take upon the Veracity of *Voyages*, *Travels*, &c.

DIALOGUE VII.

Of SHELL-FISH in General. *The BICORN with Mathematical Figures. The CUTTLE-FISH. The FISH yielding the Tryan DYE. The PHOLAS or ANGER-FISH,*

Cleonicus.

I KNOW you are fond of *Shell-Fish*, my *Euphrosyne*, and I shall serve you up with several Dishes of that sort of Luxury to Day.

Euphros. You are a good Hand at *Catering*, *Cleonicus*, I know; you always provide things quite agreeable to my appetite—But Metaphor apart, I suppose you intend to entertain me to Day, with a Discourse of what you know most curious, and most extraordinary in the various *Tribes* and *Families* of *Shell-Fish*—And I shall be all attention.

Cleon. That is my Design, my *Euphrosyne*; But this District of Nature bewilders me more than any other I have ever traversed—There are so many meandrous Windings and Turnings, that it is a perfect *Labyrinth*—There is such a prodigious Variety of *Shells* (the most extraordinary and exquisite *Fabrics* of *Omnipotence*) and such an endless Train of Inhabitants thereof, that 'tis difficult
to

to know how to begin or end our Contemplations on such an infinite Subject.

Euphros. To be sure you have exhibited a proper Idea of the Vastness of such a Survey—But let us proceed gradually, *Cleonicus*; and deal in *Generals*, and *Capitals* only, and that will suffice for me—And tell me in the first Place what Distinctions are made in the *Shells of Fishes*.

Cleon. There is such Variety in the Nature and Composition of *Shells* that it is next to impossible to class them with any tolerable Distinction—The vulgar arraignment into *Testaceous* and *Crustaceous Shells*, means little or nothing—One may say of the *Nature of Shells*, as St. Paul did of the *Glory of the Stars*—That one Shell differs from another Shell in its Nature—There is a peculiar Nature and Structure in the Shell, of a *Tortoise*—Another in the Shell of the *Oyster*—Another in the Shell of a *Lobster*—Another in that of a *Crab*—Another in the *Cuttle-Fish*—Another in the *Triangular Fish*—and an Infinity of others in all the *Conchylious Species*—There is another Distinction of Shells, according to the Parts in which the Fish is contained—If it be a *Single Part*, it is called a *Univalve Shell*, such as that of the *Sea-Ear*, the *Paper Nautilus*, &c.—If there be two Parts that open and close, it is called a *Bivalve*, as that of the *Muscle*, *Oyster*, *Scallop*, &c.—When there are more Valves, they are called *Multivalve Shells*, as all the *Polliceps* kind.—But this Arrangement of Shells is far from comprehending all, and in Truth I know of none that will.

Euphros. Well then *Cleonicus*, we will do our Business without classing, since indeed it is little less than presumptuous to pretend to limit or partition out the incomprehensible Works of Nature—But pray tell me in the next Place, how the Inhabitants of these Shells came to be called Fish? they have neither the *Form*, the *Fins*, the *Scales*, nor *Skins* of what we properly and commonly call a *Fish*, as a *Carp*, *Tench*, &c.—And what is more, many of them have *Legs* and *Claws*, which were never heard of in a *Fish*.

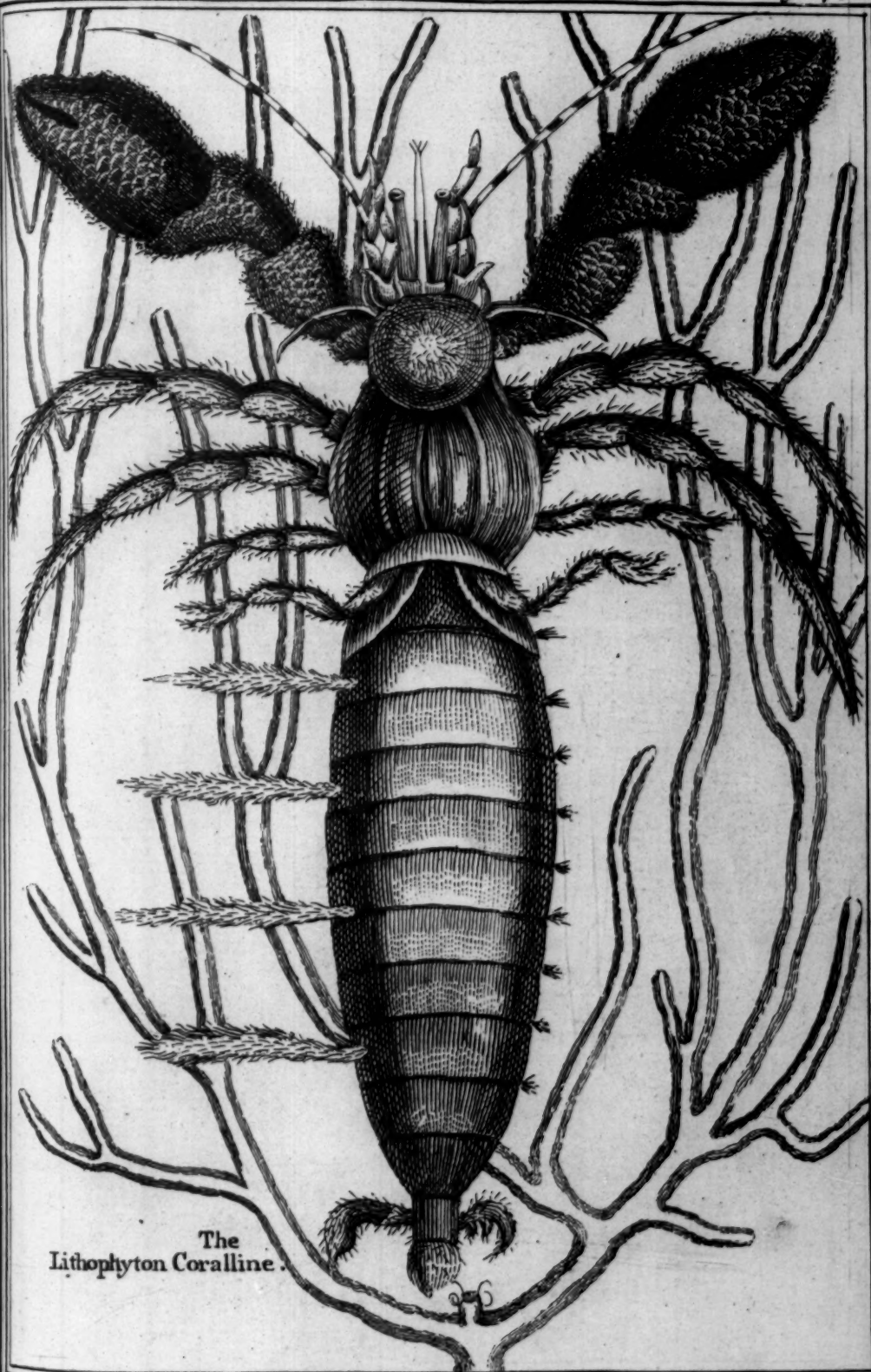
Cleon. My *Euphrosyne* is very just in her remarks—There is no more Analogy, Comparison, or Resemblance between a *Crab* and a *Carp*, than there is between



The Sea HERMIT Crab.

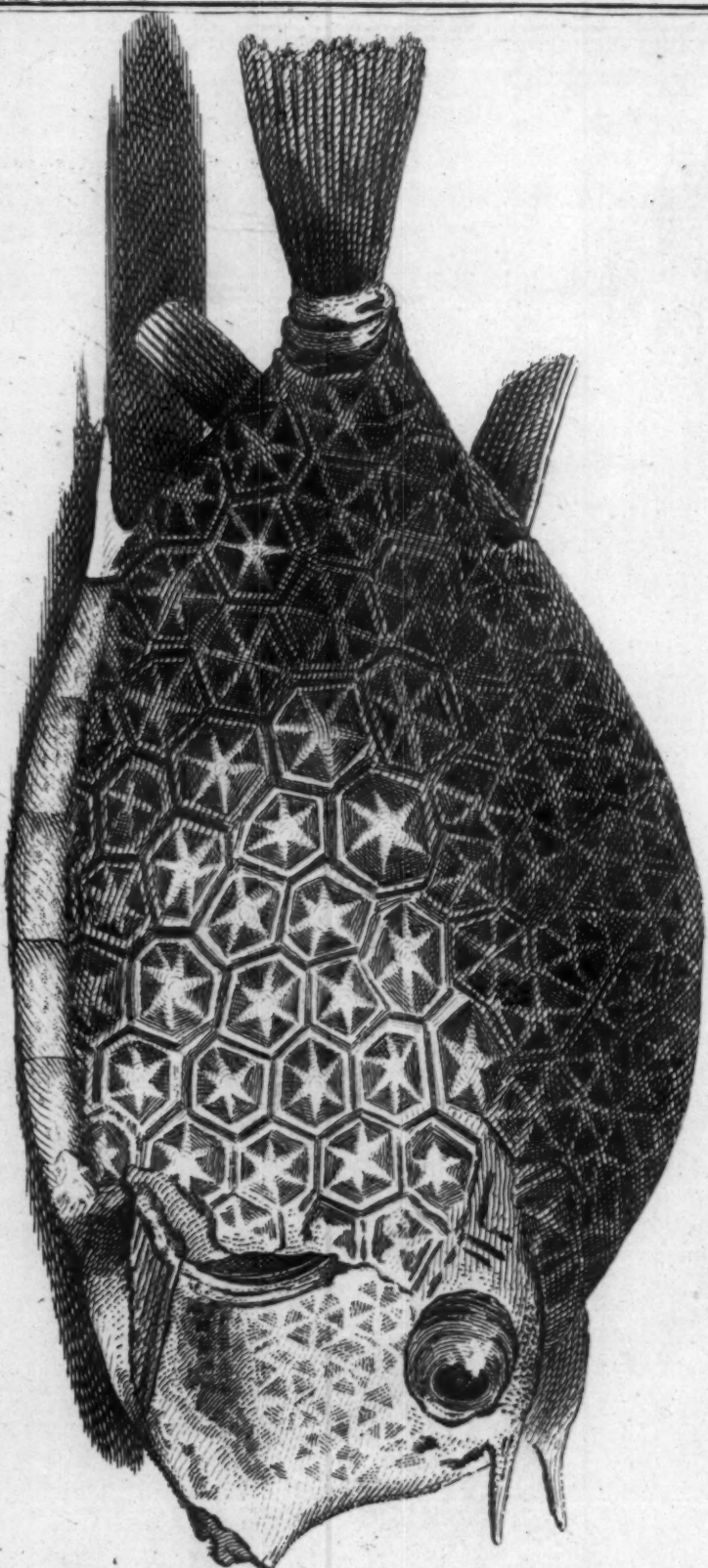
Plate XIV.

Page 174.



The
Lithophyton Coralline.

PISCIS BICORNIS (vulgo) The CUCKOLD-FISH.



a *Cat and a Cuckow*, nor half so much—It is, therefore, with great impropriety these Animals are called *Fishes*, unless you suppose every thing to be a *Fish*, that lives in Water; and that would finely become a Philosopher, indeed!

Euphros. But as custom has christened them with that Appellation, we must call them so, till we have Names more proper to distinguish them by—The wonderful Phænomena in this Province of Nature being the Subject we are at present to advert to, pray what do you first begin with, *Cleonicus*?

Cleon. As I am a little *Geometrically* inclined, any thing that discovers any Vestiges or Figures peculiar to that divine Art, I am particularly fond of, and strikes me in the first Instance—Such, my *Euphrosyne*, is the *Bicorn Fish*, the whole of which is a Specimen of *Mathematical Forms and Figures*—But this is not the only reason why I single out this Fish to begin with, for it seems a Transition from a *Common Fish* to a *Shell Fish*, as you will readily perceive from a View of a most beautiful one which I have provided on purpose for your Museum, and now present you with,

Euphros. I can but thank you, *Cleonicus*, for so great a *Marine Curiosity*—What a most wonderful and beautiful appearance it makes!—It looks as if it were cast in a Mould, or formed by a *Sculptor's Hand*—It is a singular, I may say, an *Ocular Demonstration* of *Geometrical Skill and Design*!

Cleon. It is, all over—But what I shall first observe to you, my *Euphrosyne*, is, that it has the *Mouth, Head, Eyes, Fins, and Tail*, like a common Fish, at the same Time that it has a *Coat, Case, or Covering* of curiously wrought Mail, which has the general appearance of a *Shell*—But this Shell is neither of the *Testaceous, Crustaceous, nor Conchylious* kind; nor any other kind that I know of—It is of a Nature peculiar to itself—The common Shells are elastic, and almost transparent, like this—In short it seems to be a hard and horny substance, of a *Membranous Texture*, as you will easily observe when you View it through your Microscope,

where

where you will see a curious Tissue of Threads lying between, and connecting all the different Figures.

Euphros. This I shall take great Pleasure in doing—I observe this Fish is armed both before and behind, that is, with two sharp Horns upon the top of it's Head, and the same on the Belly near the Tail—They are very strong and well pointed.

Cleon. It is therefore called the *Bicorn* or *Two-Horned* Fish.—It has improperly been called the *Triangular Fish*; I suppose, from its three Plane Sides, two of which join at Top, and make the rigid Back of the Fish; and the other Side forms the flat Belly.—The Body of the Fish, or Shell, appears somewhat of the *Swinish Cast*.—It is evident from its *Gills* and *Fins*, that it respire and swims as other Fish do—and its Mouth, like theirs, is furnished with Teeth.

Euphros. Indeed it appears to have all the Properties of ordinary Fish, except Skin and Scales—at a distant View I should have thought those Figures upon the Body had been real Scales.

Cleon. I suppose it must have been owing to a Surmise of that Kind, that we are told by some Naturalists, that there are some Fish which have Scales in Form of *Pentagons* and *Hexagons*, that is, of *five* and *six* Sides.—But I never saw any Fish with such figured Scales in any Fish-Market in London.—Nor do I think, from the Nature of the Thing, there are any such Scales at all.

Euphros. I have been telling the Sides of many of those Figures, and find they are *six*, and the Figures *Hexagons*, of Course, as you call them.

Cleon. They are so in general, but if you look narrowly you will find here and there a *Pentagon*.—But what is singular and deserving your Notice in this *Geometrical Configuration* is, that on each Side the Fish there is in the Middle (over the Shoulder, as I may say) a larger Figure of seven Sides, or a *Heptagon*;—And that this is joined by its seven Sides by seven other Figures, six of which are *Hexagons*, and one only a *Pentagon*.

Euphros. Could an *Atheist* desire a more full and convincing Proof of *Design* and *divine Geometry*? Well, I shall take an Opportunity, when alone, to examine the
Texture

Texture of this Shell, both by the *Megalaſcope* and *Microſcope*, for I can ſee enough with my Eye alone to inſure me much Pleaſure in ſo enlarged a View.

Cleon. For that very Purpoſe, my *Euphroſyne*, I have brought a Piece of the Skin or Shell, cut out of the beſt Part, which will exhibit a delightful View of the curious *Tubercles* with which the Fiſh, and all its Figures, are ſtudded; the *Parallel Threads* which connect the Figures with the *Transparent Membrane* on which they lie, &c, &c. But we ſhall now turn our Thoughts from one extraordinary Fiſh to another.—

Euphrof. And pray what do you call that, *Cleonicus*?

Cleon. The CUTTLE-FISH, my *Euphroſyne*, as great an Oddity as any in *Neptune's Dominions*.—It has a Shell upon its Back about ſix Inches long, and three or four wide.—The outer Part of the Shell is thin, ſmooth, and cruſtaceous.—The inner Part (when dry) is ſoft, perfectly white, and is reduced to a fine White Powder, that we call *Pounce*.—This is an Inch thick.—But though it be ſo white in one Part, it is black enough in another—for it contains a Liquor in its Body which exceeds any *Ink* in Blackneſs, which it can readily throw out upon an Attack from *Fiſh* or *Fiſhermen*.—This Fluid ſo *blackens the Water* all around, that it conceals itſelf therein, and cannot be eaſily found. Again, it has ſuch a horrid *Apparatus* of Parts about its Head, as would almoſt frighten you to look at it;—conſiſting of eight Legs or Arms, and two long Parts, like Feelers, which make it ſeem to be of the *Polypus* Kind.—It has a ſtrong Beak like a Parrot's—and very large goggling Eyes.—I once ſaw, and examined one of them alive, and can truly ſay, I never before beheld ſo very ſtrange and frightful a looking Animal.—The *Fiſhermen* aſſured me their Beak was ſtrong enough to bite off a Thumb or Finger, which made them very cautious how they handled it.—There are prodigious Quantities of theſe Fiſh, and of their Shells, upon all Sea Coaſts every where.

Euphrof. I think the Cut you ſhewed me of it, in *Swammerdam's Book of Nature*, muſt needs repreſent the Life, and ugly enough it is.—I would not come near it alive, for the World.

Cleon. Well, there is one of those Shells for your Cabinet, my *Euphrosyne*.—And in the next place I shall present you with another small Shell very suitable indeed, for the sake of the Fish who once inhabited it.—

Euphros. I am vastly obliged to you *Cleonice*, for it; but truly I should have thought it had been only a *Perriwinkle-Shell* from the Appearance it makes.

Cleon. It does look like such a mean Shell indeed; but when I tell you the Fish that once belonged to it, yielded a Fluid or Liquor, that, for striking a fine *Purple Colour*, surpassed even the *Tyrian Dye*, if possible.—I have seen the Fish alive, and the Bag in it, containing this *Purple Fluid*,—I took some out by puncturing the Part with a Needle, and letting it drop on a Piece of Cambric, it produced the most intense and beautiful *Purple Tint* that I ever beheld.—And every Time the Linen stained with it, is washed, the Colour is very much heightened and meliorated.—It is found in Plenty on the Coasts of *Cornwall*.—And the *Connoisseurs* there say, it is certainly the same Fish as the *Tyrians* of old obtained their *Purple* from, so celebrated through all Antiquity.

Euphros. Well, I shall set a great Value on the Shell of so singular a Fish.—Pray, *Cleonice*, what is the next Subject by which you intend to excite my Admiration?

Cleon. An Instance of the wonderful Diversity and Variety in the Works of Nature, in which some Parts most astonishingly contrast others.—We have seen the Fowls of Heaven in their Flights survey Countries, and Kingdoms, Lands and Seas.—Also Fishes range the unbounded Deep—while other *Animals* are destined to Gloomy Abodes, and in the most lonesome Domicles, which they are obliged to make for themselves in the hard Opacous Substance of Stone itself, and in which they cannot move forwards or backwards one half Inch, and Sideways not at all.

Euphros. Good Heavens! what forlorn Creatures must these be! Pray tell me what you call them, *Cleonice*.

Cleon. The *Naturalists* call it the *Pholas*, but it deserves more the Name of the *Auger Fish*, as it has a Faculty of boring Holes by turning itself round and round, and having the Ends of its Shell (when close) furnished with hard

hard Parts fixed slant ways, so that as it turns, it cuts it's Way into a Stone, as an Auger by its wormed Point cuts its Way into Wood.—But to give a better Idea of so wonderful a Fish, I have procured several Pieces of Stone, with the Fish in the Holes exposed to View—see, here they are, my *Euphrosyne*.

Euphros. A wondrous Spectacle this!—Stones perforated with Holes in abundance.—The same Holes of different Magnitude from the Beginning where they are smallest.—The Shells of Fishes that made them, remaining in those Holes—some half out and half in—they all proceed obliquely from the Surface downward.—The Shells all so exactly sized to the Holes, that there is no Room for moving any way.—Pray, *Cleonicus* how do they live imprisoned as they are, in these close and stony Cells for Life?

Cleon. Their Aliments are brought to them by the *Sea-Water*, which in every high Tide overflows the Stones, and fills these Holes.—They can just find room to open their Shells a little way to let in the Water, and then like Muscles and Oysters, they live on what they find in it.—They have, besides, a fleshy round Part which they protrude from the hinder End of the Shell, and how far this may contribute to the Subsistence of the Fish I do not know, but I imagine, not a little.

Euphros. I see they are a *Bivalve* Fish, not much unlike some Muscles in Form; but the two Valves unite so closely before, and are so peculiarly fabricated, that I can easily conceive how they bore those Holes, and why they must necessarily be bigger and bigger as the Fish grows older and larger.—But how they can begin and infallibly succeed in so arduous a Task in their Infant State, is not so easy to apprehend.

Cleon. The Works and Ways of Providence are ever certain and successful, though we cannot comprehend them.—One Thing in these *Pholas*, is very observable, and that is, that in all their Perforations, they never infringe upon each others Property, or break into each others Apartments, though sometimes the Partitions are so exceedingly thin, you may almost see through them.—These Fish abound on the Coasts of *Cornwall*, and

most other Countries.—I have different Sorts and Sizes of them, but none larger than two Inches—another Sort not above one Inch.—The *Stones* also which they inhabit, are very different ; but mostly such as I have brought you here.

D I A L O G U E VIII.

REFLECTIONS on SHELL-FISH continued. *Of the Land and Sea CRAB. The HERMIT-CRAB. Of the singular MOTION of CRABS. Of LOBSTERS, and their EYES. Of OYSTERS. Of the NAUTILUS, or Sailor. MOTHER of PEARL. PEARL-OYSTER. Of a SILK MANUFACTORY from SHELLS. Of the Land and Sea TORTOISE, or TURTLE.*

Cleonicus.

IN continuing our SURVEY OF SHELL-FISH, I shall endeavour to amuse my *Euphrosyne* with a few Remarks on some of the most Common Fish of that Kind, CRABS and LOBSTERS; where they not common, their Form would be thought admirable, and the Movement (of the *Crab* at least) very singular.—Their *Shells* are of the *Crustaceous Sort*, sustaining the *Flesh* within, in lieu of *Bones* in other Animals,—With regard to the CRAB in particular, there are two Kinds, the one a *Land Crab*, the other a *Sea Crab*.—The Land Crab is found in many Parts of *America* and the *East-Indies*,—it makes Holes or Burroughs in the Ground, like Rabbits.—Climbs up Trees—and all small, Animals, Reptiles, &c. that come in it's Way, are its Prey.—There are many Sorts of Land and Sea Crabs—particularly one called the *Hermit Crab*, of a very particular Make.—The Head is on the fore Part of the Body, which is covered with a *Crustaceous Shell*,—the hinder Part is of a *fleshy Substance* about four Inches long,

long,—This Part it thrusts into *empty Shells* which it finds deserted by other Fish, to which it can strongly fix itself by Hooks and Claws in the End of the Tail.—And thus with its own Shell and the borrowed Shell together, it is secure from harm, and shifts for a Living, for which Purpose it is provided with eight *Legs*, two large *Pincers* or *Claws*, and *Feelers*, as in common Crabs.—And two Eyes standing an Inch out of its Head.—There are some small kind of Fish in *Cornwall*, which drive *Perriwinkles*, &c. out of their Shells, and get into them themselves, and there live always afterward—these I have often seen—they call them there the *Soldier-Fish*.

Euphros. Why these *Hermit* and *Soldier-Fish* seem from your Account of them, to be *naturally Free-Booters*, and live by plundering other Fish of their Houses and Possessions.—We look upon such Proceedings among ourselves as violent and criminal, *Cleonicus*; pray how do you excuse these Shell-Fish Thieves?

Cleon. By saying, they are not governed in their Actions by REASON and LAW, as we are, or ought to be.—*Might* or *Power* is the only Rule of Life to all the Brute Creation.

Euphros. You have said a good deal, *Cleonicus*, but not quite enough to satisfy all my Scruples.—I observe they are sent into the World but half provided for—one Part covered, and the other Part naked; for which it is obliged to get Clothing by dint of Rapine—this sounds very strange to me.

Cleon. Sound as it may, it is Matter of Fact.—I have often seen the Fish, and observed its Actions, both in and out of the pilfer'd Shell—but as I remember, this *Cornish Adventurer* appeared more like a *Prawn* than any other Fish.—And when I have dragged them out of their new-acquired Shells, they appeared greatly hurt, and in a piteous Plight indeed, till they got in again.—But to return to the *Common Crab*, and common as it is, did you ever see it *walk, move, or run along* upon the Ground, *Euphrosyne*?

Euphros. I cannot say I ever did, *Cleonicus*.—I see them often sprawl, and throw their Legs about, but don't

recollect that I have seen them move from one Place to another.

Cleon. Almost all Creatures move with their Head foremost, except the Crab, whose *Head and Tail* are always in a lateral or *Side Position* when they move.—Again, few Animals can go backwards, with the same Ease as forwards, but it is equally indifferent to the Crab, which Way it moves; for as it moves *Sideways*, it can go to the right or left at pleasure—and if you observe the Position of the Legs and Claws upon the Sides of the Crab, you will be convinced that they must move in that lateral Manner.—I have often diverted myself with viewing these Modes of Motion in *small young Crabs*, left upon *Salt Marshes* by the Tide.

Euphros. How would such a Sight delight me! But we cannot be every where, nor can we see every thing.—Pray, *Cleonicus*, what curious Anecdotes have you concerning *Lobsters*?

Cleon. LOBSTERS are a Species of Shell-Fish, also, so well known that all the external Parts describe themselves to my *Euphrosyne's* Eye.—But there is one of the internal Parts, that has a particular Conformation, different from any other Animal whatever, and that is, that it has *Teeth in its Stomach*; three large Ones, one on each Side, and a third behind; so that a Lobster's Stomach serves both for Mastication as well as Digestion of its Food.

Euphros. Now you mention it, *Cleonicus*, I recollect seeing hard, brown, Parts in the Body of a Lobster whenever I pull it to Pieces.—But little did I think that the Part in which I saw them, was the *Stomach*, or that they were the *Teeth of the Creature*.—An Instance, how often we see and eat we know not what.—

Cleon. It would not be convenient for you always to know what you eat and drink.—But this is not the only Peculiarity of the Lobster-kind, my *Euphrosyne* will find something Novel in the *EYE* of a Lobster as well as in the *Stomach*, and afford her *Employment for the Microscope* in a superior Degree even to the Eye of the *Libella* itself.

Euphros. Well, I long to hear you say what that can be, *Cleonicus*.

Cleon:

Cleon. It is the *Cornea* of the Lobster's Eye, my *Euphrosyne*, which is filled with Lenses in the same manner as that you see in the *Libella*, but with these Differences, they are of a *Square Form*, and *much Larger*.—I have prepared a Piece, and placed it under the Microscope, for your View—there, look at it——

Euphros. A Novelty indeed! what beautiful Squares they are! how truly so—I see you have put a Piece of the *Libella's* Eye just by it, so that I see them both in one View, but the *Quadrangles* of the *Lobster*, are indeed much larger than the *Hexagons* of the *Libella*.—I think they look a good deal like a Piece of *Mosaic Pavement* I once saw—I further observe, they are true transparent Lenses, as they make very perfect Images of distant Objects—Pray, have *Crab's Eyes* any such quadrangular Lenses, *Cleonicus*?

Cleon. They have, *Euphrosyne*, but they are rugged and irregular, and make no pleasant View in the Microscope.—In *CRAW-FISH*, on the contrary, you have the largest and most pellucid *Animal Lenses* of any yet discovered.—This Fish is but a Species of Lobsters, and also all the inferior Orders of *Prawns*, and *Shrimps*, even some *Animals* found in Pump-Water, so small, that they are but *Microscopic Objects* themselves, though they have Parts every way similar to those of *Lobsters*.—Concerning all these kinds of Shell-Fish, *Crabs*, *Lobsters*, &c. it is asserted by *Fishermen*, that when they accidentally loose a Leg, Claw, or any other Member, it grows again—that they *cast*, or *change their Shells* every year about *May*, is asserted by Naturalists, but having never heard it authenticated by *Fishermen*, I shall say no more of it.

Euphros. Pray, *Cleonicus*, can you tell any thing more about *Oysters* than what the *Old Oyster-Women* know?

Cleon. I fancy very little, my *Euphrosyne*; for Experience teaches them every Day with what an amazing Force this Animal can hold the two Valves of his Shell together, so as to acquire a great Power to be exerted with their stubbed knives to separate them, that you may have the strange Sort of Pleasure of *Eating them alive*.—One thing is very remarkable, and that is, the immoderate Size to which they grow in some parts of the

World—I have seen an *Oyster-Shell* so large as to weigh, at least, two Hundred Pounds, and have heard of others still larger.—The manner of Life in *Oysters*, *Muscles*, *Cockles*, *Scallops*, and all such kind of Bivalve-Fish, you will be better informed of by some people at *Colchester*, than by any Philosopher in the Land.

Euphros. Those Shells called LIMPETS and BARNACLES, I know very well *Cleonicus*; but I never saw the Fish that inhabited them.——

Cleon. That is because you have never lived by the Sea-Side, for there you would see them by Thousands every Day.—The *Limpet* fixes itself strongly to some solid Body, within the Shell which you have seen often—— This Shell is single, or a Univalve of a *Conical Form*, and some of them beautifully coloured on the Inside—As to the *Barnacle*, that is a *Multivalve* Fish, whose Valves open at the top, where the Fish puts out its Arms to take Food or Prey, whatever it be.—They firmly adhere to Stones, Rocks, Sides of Ships, &c. and grow in Clumps of many together—some of these are variegated with stripes and coloured Tints, very agreeably.—Here is a Cluster of *Barnacles*, my *Euphrosyne*, will not disgrace your *Museum*.

Euphros. So far from that, that it is certainly a great Beauty and Curiosity—I see you have another curious Shell here, which I presume you intend also to oblige me with—pray what do you call it, *Cleonicus*?

Cleon. It is called the NAUTILUS (or *Sailor*) because the Fish, when alive, has a faculty, contrary to most other Shell-Fish, of *Swimming* on the Surface of the Sea.—To answer this purpose the better, you observe the Shell is extremely *thin* and *light*; being of the *Turbinated* kind, the Volutes or hollow Parts, contain Air, and render it boyant at the will of the Fish, which can easily ascend and descend in deep Waters, though it chiefly affects to be near the Shore.—*Pliny* says it is one of the principal wonders of Nature, because it can swim on the Surface of the Sea like a *Boat*——they are frequently seen about the Cape of *Good-Hope*—and delight to be on the Surface, when the Water is calm—and it is pleasant to behold how they manage themselves in the Water

Water—their Shells serve them for Boats—they raise up their Heads, and spread out a Membrane in Form of a Sail, and though it be thin as a Spider's Web, it is strong, and will hold the Wind very well.—Things being in order, away they sail, always upon the right Point of the Compass to obtain their Ends.

Euphros. What a Pleasure would it afford me to see such an unusual sight! I must set a great Value on the Shell of so *Singular* a Fish—Pray, *Cleonicus*, from what Fish, have we such Quantities of *Mother of Pearl*?

Cleon. It is the substance of many different Sorts of *testaceous Shells*, but chiefly of the *Turbinated kind*, or such as have a large Bone and several Spirals or Whirls, which terminate in an Apex or knob on the upper Part—Others say they are made also of Oyster-Shells—But this fine large Whirl, or *Voluta* (which I present to your *Museum*) you observe my *Euphrosyne*, it has the appearance, and really is *Mother of Pearl* all over, both within and without, with all its variable *Tinges* and *Colours* which you see in your Snuff-Boxes and Fishes at Cards, &c.

Euphros. This is a fine natural View of it indeed, for which I am greatly obliged to you—Pray, *Cleonicus*, are not these costly Ornaments, we call *Pearls*, the Produce of *Sea-Shells*, likewise?

Cleon. They are found in large Oysters in the *Gulph of Ormus*, and other parts of the *East-Indies*; besides which, there are many other Shells which produce *Pearls*, which are only a *preternatural Excrecence* of the Fish, though they are so much admired by your Sex, but I think you are just as handsome without *Pearl Necklaces* and *Ear Drops*, as with them.

Euphros. You Philosophers are odd sort of Gentry—But pray, what other Wonders have you to relate of Shell-Fish, *Cleonicus*?

Cleon. Here we find *SILK*, too, in great Abundance, insomuch that the Ancients had a *Manufacture* of *Silk*, and which about forty years ago, was revived at *Tarento* and *Regio*, in the Kingdom of *Naples*.—It consists of a Brown strong Silk belonging to some Sort of Shell, of which they made *Caps*, *Gloves*, *Stockings*, *Waistcoats*, &c.

warmer

warmer than the Woollen-Stuffs, and brighter than common Silk.—I have seen such kind of Silk in Shells, myself; I think it was of the PECTEN kind, but can't be sure—It makes a very strong Hinge for connecting the two Vaves.

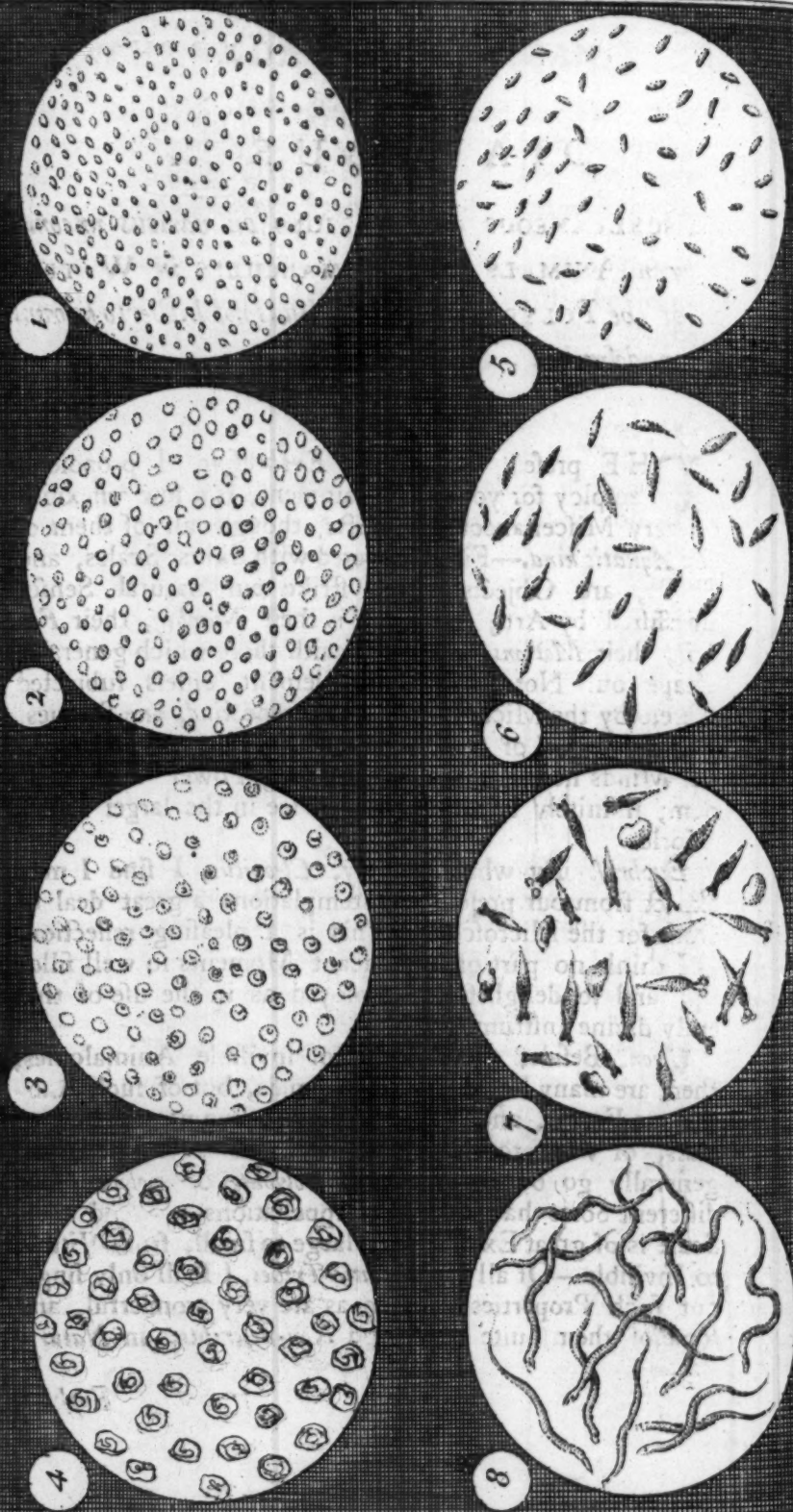
Euphros. Well, *Spiders*, *Catapillars*, and *Fish*, supply Mankind with what, with all boasted Skill, they cannot make or produce themselves!—Pray what is the TORTOISE or TURTLE, *Cleonicus*, is it a Shell-Fish or not?

Cleon. It is rather a *Shell-Animal* my *Euphrosyne*, destined to live both on Land, and in the Sea—The Body is contained in a large Shell below, which is joined to another very broad and curiously wrought Shell on the Back as a *Covering*, and a *strong Coat of Mail* for Defence.—Besides the various coloured Flesh, the *Callipath* and *Callipee*, esteemed such Ambrosial Diet by People of high Taste, they lay *Eggs* as large as those of a Goose, twenty or more together, which they place in Holes they make in the Sand on the Beach, and leave them to be hatched by the Heat of the Sun—These Eggs are said also to be a very delicious Eating.—The Shells of the Land-Tortoise have much *finer Configurations* on the upper Part, than those of the Sea; but the internal Part of all *Tortoise-Shells* affords a most noble and beautiful Substance for the *Manufactory* of *Tortoise-Shell* Ware of many kinds—What can be more elegant than a *Tortoise-Shell Snuff-Box*, with a compleat small Land Tortoise Shell for the Lid, all set in Silver—And such a one I here present my *Euphrosyne* withal.

Euphros. What a fine Effect of Nature and Art conjoined! how much more elegant than in *Silver*, or *Gold* itself! *Mother of Pearl* does not compare with it; that is Nature all over Polished; this, her simple and Native Appearance—When ever I see it, I shall think of my dear *Cleonicus*.

DIALOGUE

MICROSCOPIC VIEWS OF ANIMALCULÆ in FLUIDS.



DIALOGUE IX.

MISCELLANEOUS REFLECTIONS *on various uncommon ANIMALS and ANIMALCULES in WATER, of the POLYPE, and other Kinds not hitherto known or described.*

Cleonicus.

THE present Hour, my *Euphrosyne*, I propose to employ for your Entertainment, is a few reflexions on very Miscellaneous Subjects, though all of them of the *Aquatic kind*.—Fishes covered with Skins, Scales, and Shells, are Objects which strike our natural Senses unassisted by Art; but what is their *Number*, their *Fabric*, their *Motions*, compared with those which generally escape our Notice in that Element, unless subjected thereto by the Microscope? yet not one *kind*, one *Species*, one *Individual* of these Animalcules but what opens to our Minds new Scenes of amazing Power and Wisdom, infinitely beyond what we see in the larger visible World.

Euphros. By what you say, *Cleonicus*, I find I may expect from our present Contemplations a great deal of work for the Microscope; This is a pleasing reflection, as I think no part of my vacant Moments so well filled up, and so delightfully employed as in the use of that truly divine Instrument.

Cleon. Besides the Myraids of invisible Animalcules, there are many large aquatic Animals, but of such Anomalous Forms, and Nature, that one knows not how to class, or what to call them—What I mean, however, generally go by the name of *Polypuses* or *Polypes*; but different Sorts have different Appellations—And their Scale is of great Extent, from large to small, from Visible to Invisible—Of all the *Aquatic Tribes*, I shall only single out such Properties of each as are very wonderful, and some of them quite new, and *Non-descripts*, in *Natural History*.

Euphros.

Euphras. Well, *Cleonicus*, I long to hear you proceed in your intended Rehearsal.

Cleon. The first subject is a great Novelty, as well as Prodigy of the deep—it is an Animal which was left by the Tide on the Sea Beach near *St. Agnes* in *Cornwall*—The Body of this Animal was as wide as the Palm of the hand—and on the under side was a Sort of Bag or Pouch, like a Purse, into which the Animal had collected and disposed of its Legs; and seemed to be in a State of *Repose*—The Legs, or Arms, which proceeded from the Body were in Number eight, at equal Distances, and nearly of equal Length, about thirty Inches long—They were of a dark Membranous fleshy substance—And on each Leg, on the under Part, were a great Number of *Pouches*, or *Holes*, (the largest about half an Inch wide) from the Body quite to the End—Both the Legs and Holes proceed from the Body tapering to a Point—Of these Holes, there were between thirty and forty in each Leg.—The Animal is supposed to respire by them as Fish do by Gills—On the upper Part of the Body in the Middle was a Part like a curious Beak or Bill; an Inch and a half long; three fourths wide; of a Tortoise Shell Colour; and curved like that of a Parrot—How great the Power and Force of this Creature must be when alive, the Person who surprized and subdued it, can only tell, who says, it was incredible—When properly expanded it fills a Circle five Feet in Diameter—and as such an Animal is no where else to be seen, I beg my *Euphrasyné's* Acceptance of this, which I have carefully prepared for her *Museum*.

Euphras. You will make me as rich in Rarities, as some of my Sex are in Jewells, *Cleonicus*.

Cleon. If *Wisdom* be more valuable than Rubies, then will my *Euphrasyné* be much richer—the next Specimen of infinite Contrivance that I shall mention, exceeds all description, and all admiration.—A little Sea-Animal, whose Body is not bigger than an Half-Crown, sends out from every Part around, such an amazing *Apparatus* of Arms, or Legs, or whatever you call them, in such an Infinity of *Ramifications*, and *Divarication* of Parts, all connected together in various Curls and Configurations,

to the extent of three or four Inches all round the Body, I say such a Creature will give my *Euphrosyne* an Idea of what a prodigious Expence and Profusion of Parts Omnipotence does sometimes think fit to be at, to furnish the most insignificant Animal the Means of procuring the small Quantities of Aliments it may require—What wonderful powers and Faculties of Motion and Sensation must such a Creature be possessed with, to actuate, and move every Part of such an Ambages of Filligree-Net-work, to compass their Prey, and convey it to the Mouth!—of this surprising Spectacle I shall procure my *Euphrosyne* a very fine View e'er long.

Euphros. Nothing will more oblige me, my dear *Cleonicus*—To these stupendious Instances of Creating Power, what do you find to add in the third Place?

Cleon. I think there is another GENUS of *Sea-Animals*, which have Properties almost equally wonderful, and of so strange a *Nature* and *Form*, that I know not what to call them—they seem to me to be a sort of *Animated Plant*—they grow upon the Surface of Rocks, Pebbles, Stones, &c. and so exceeding firmly, that they cannot be separated without destroying them—they are of various Species and different Sizes—the smaller Sort have Bodies, with Parts like Leaves, and resemble *Flowers*, when expanded—they are of different Colours and Hues, and one Species in particular, is called the *Sea-Anemony*, from its appearance like that *Flower*.—Of the larger Sort, upon large Stones, there are some that resemble young *Aloes*, with many thick tapering Arms, like *Aloe-Leaves*, issuing from the Body all around—these Arms, when fully extended, fill a Circle six or eight Inches Diameter, and more—they are beautifully coloured, and variegated with tinged *Stripes*, *Spots*, &c. so as to render them a delightful, as well as wonderful Spectacle, to those who never saw them before—they abound in many Parts of the British Coast, particularly at Hastings, and Weymouth, where they are large and finely decorated with Colours.

Euphros. And are you sure, after all, *Cleonicus*, that these Creatures are real *Animals*.

Euphros.

Cleon. This is evident from their actions and Voluntary Motions of all the Parts of their Bodies—they are very ready and dextrous at catching and devouring their Prey.—I once dropt a small live *Crab* (about an Inch wide) upon the Body of one of them, which immediately threw all its Arms over it, and inclosed it entirely—when thus folded up, it looked like a *flatted Artichoke*, and about the size—it continued thus for near a quarter of an Hour—then it unfolded it's Arms by degrees, and nothing was seen of the Crab.

Euphros. This is proof enough of its Animal Nature—but pray, *Cleonicus*, is it not a-kin to the *Polypus*, of which I have heard so many incredible Things?

Cleon. Very little; the *Polypus* is a small Microscopic Animal, and is at Liberty to move where it pleases—on the *lower* (or Tail-Part,) of the Body they fix themselves to the stems of Plants, Sticks, &c.—on the upper Part of the Mouth, it has various *Arms*, or rather *FEELERS* from it's Periphery.—This form of the *Polype* is evident to the Eye, applied to the Glass fixed over them on that *Tumbler of Water*, my *Euphrosyne*.

Euphros. Good Lack, I see them with all the Distinctness imaginable!—they are fixed on their Tails, some to the Bottom, and others to the side of the Glass—I observe their *Arms* or *Feelers* proceed from the Rim of their Mouths, on the upper Part of their Bodies—that they are of a clubbed form, slender at Bottom, and grow larger at the Top—that they are not smooth, but of an uneven rugged Surface—that they turn and weild them about every way—also protract and draw them in and out.—I observe their Bodies are considerably altered since I have been viewing them—some that were long and slender, are now short and thick—I see they can also extend their Bodies, and incline them towards any part.—The whole is wonderful to behold?

Cleon. And yet you have not seen one *hundreth Part* of the Wonders this Creature will exhibit to your View in a continued series of Observations which you may make upon it at your Leisure—you will see it grasp long slender Worms, and devour them by degrees—you will see a Young *Polype* grow out of the Side or Body of the old one,

one, with the Arms growing to an adult State, and then drop off, to skift for itself.—You will see Two, Three, or more of these Young Polypes growing from the Body of the Old one at the same Time—some just pullulating, or budding out, and others full grown and falling off—Nay, from some of the larger young ones, you will see other young ones grow, even before the first young has fallen off;—So that in one Polype you will see three generations existing at once.—Such a method of *generating* and *propagating* the *Species*, is so singular, and peculiar to this Animal, that the like is not to be found in all Nature besides!—every Polypus being of itself and alone able to raise a most numerous Posterity by a kind of ANIMAL VEGETATION—But what is the last of all Wonders, that which *kills* and *destroys* all other Animals, *produces* and *propagates* this, and that is by *cutting it to Pieces*—strange to say, yet not more strange than true—If a Polype be cut into two Pieces, cross-wise or length-wise, it matters not, each Piece in less than two Days becomes a compleat Polype, with Body and Arms as at first—These again cut into other Pieces, produce so many other Polypes; and so on to Infinity—Add to this a very great oddity, if you turn the Polype; *inside out*, it seems to feel no inconvenience, but lives and acts as before in its Natural state—In some Polypes the Arms or Feelers are so long as to fill a Circle of six Inches Diameter—some of these Prodigious Phænomena I shall assist my *Euphrosyne* in demonstrating by actual Experiments at proper Seasons.

Euphros. What signal Instances these of Almighty Power and Wisdom—and I suppose, *Cleonicus* you intend to furnish me with more, by this *Pan of Water* which I see here.

Cleon. Indeed I do, my *Euphrosyne*; It is Water in which some *leaves of a Vine*, have been some time past macerating—about the Edges of these Leaves are produced, in infinite numbers, a Sort of Animalcule which is of a most singular form and construction, not to be found in any other—the Body almost in form of a small *Hand-Bell*, to which is fixed a fine transparent Thread or Filament, which is of a very elastic Nature, as appears
by

by the Animal's having a Power of *coiling* it into a *Spiral Form*, and thereby shortening it; or uncoiling it at pleasure, when it wants to throw it self out at a Distance—a number of these Threads are connected together in a *Nodus* or Knot on the Sides of the Leaf all around—I have taken a piece of the Leaf, and placed it under the Microscope, in the best point of View for your inspection.

Euphros. Oh, I see them very finely displayed in the Water—what a number of curious little *Animal Bells* there are! some of the Threads appear perfectly strait and pellucid—some half uncoil'd—and behold, just as I spoke, one snatched himself back to the leaf in a moment—another springs out as suddenly, as far as it can for its string—when at their full length, I see them turn out nearly one half of the Body into a large Rim or Mouth—many at full length,—I observe, them move their Bodies this way and that, in a Sort of vibrating Motion, where I suppose they seek and find their Food in the Water—I moreover see a small part moving extremely quick within the Verge of the Mouth—I suppose this must be the means of getting its Prey, by such agitation of the Water.

Cleon. No doubt of it, my *Euphrosyne*; but we shall see more clearly yet the wonderful Provision made for another Species of Animalcules to procure their Subsistence by a strange motion of the Water about them—I have placed some of these in the Microscope for your View.

Euphros. What strange odd Sort of Creatures are here! some look like *double-headed Monsters*.—By and by they draw their Heads in, and seem to have none at all—then they become round, and tumble about like a Foot-Ball—then they thrust out their Heads again, and extend their Bodies to a great length.—A strange kind of *Proteus* this!

Cleon. What you take for *two Heads*, if you look very attentively at them, you will observe are not such, but quite different Things.

Euphros. I see my mistake very plainly—they are *two round Wheels*, prodigiously swift, in a perpetual motion—
The

A Singular Species of ANIMALCULÆ

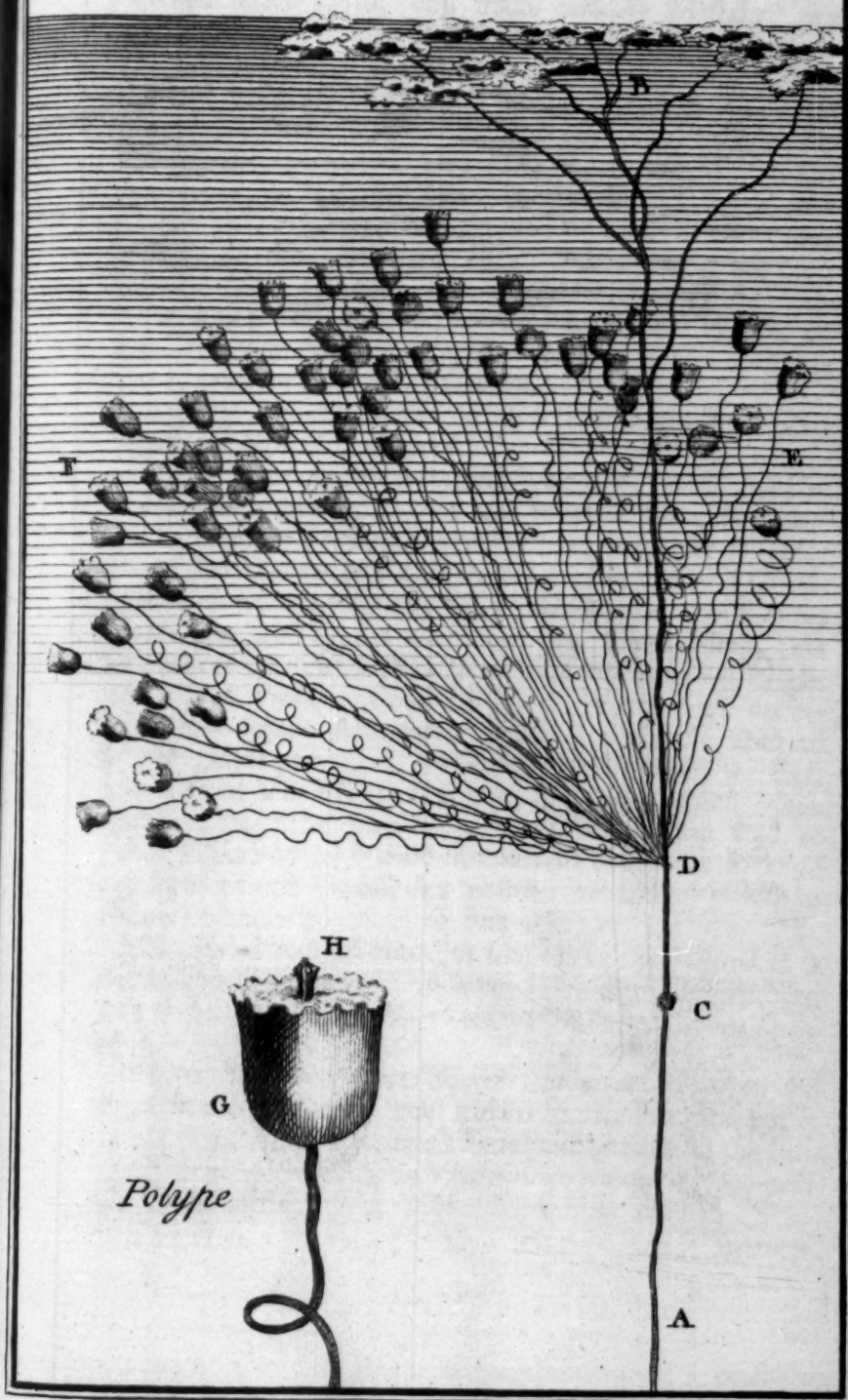


PLATE 201

A SINGLE SHIP OF ANTIQUITY

They resemble the *Fly of a Jack*, while the Meat is roasting.

Cleon. Here again, you make another Mistake, my *Euphrosyne*, as every Body else does in this Case—the Parts you take for *Wheels* consist only of very fine Vanes, like those of a *Smoke-Jack*; these being placed in a circular Manner, and severally moveable at the same time, occasion the Deception.—If you look above, the Water appears in a Vertiginous Motion, and brings down in a *Vortex* the Food for the Animal.—This is the Short History of the celebrated *Wheel-Animal*, as it has been called.—You will observe at times many other Animalcules which live by making Vortices in the Water, by Faculties and Means altogether unknown and invisible to us, even by the best of Glasses.

Euphros. Pray, *Cleonicus*, what have you got here, that looks like *Grains of Wheat*?

Cleon. They really were such once, but were blighted in the Ear, then taken out and reserved for one of the most stupendious and instructive Experiments the *World of Connoisseurs* have ever yet been blessed with.—These *Grains of Wheat* were given me by a Gentleman about three Years ago, who said it was about two Years before, that he plucked them from the blighted withered Ear.—A Blight you know, consists in nothing but Eggs deposited on vegetables.—Some unknown, perhaps, invisible Sort of Fly or Insect pierced these Grains of Wheat in the Ear, and therein deposited a Quantity of Eggs, which when hatched, has filled each Grain as full as it can hold of small Animals of the *Vermicule* kind.—I take off a Piece of the Skin of one Grain, and you see something White as Snow lie under it.

Euphros. I do, *Cleonicus*, it looks like the Kernel of a Walnut when the Shell is taken off.—But I see nothing like Animals in any Shape.—Sure there can be no LIFE in that dry White Lump.

Cleon. But surely there is, my *Euphrosyne*; for you see I take a small Piece of it on the Point of a Pin, and put it into a Concave with a little Water, and place it in the Sun under the Microscope, and then if you view it, you will see Wonders.—

Euphros. I see the small Piece you put into the Water dissolving by degrees—or, rather, resolving itself into something like small short Pieces of *knoted Threads*.—These Knots gradually disappear, and the Threads become straiter and straiter.—Believe me, *Cleonicus*, I see some of them begin to move—to extend themselves—to swell out in the middle.—Life seems to animate the whole Mass.—They are all actually become living Creatures—in every respect like the *little Eels* you formerly shewed me in Vinegar.—They are now all alive and merry, playing every way in and about their Pond of Water.—What a wondrous Scene of *Life-inspiring Power* is here!

Cleon. You learn from this Experiment that Myriads of invisible Insects may lie concealed in their *Nympha State* for Years, and yet after that become living Creatures in Waters where they fall, making all that infinite Variety of Animalcules we see abounding therein.—And at last, after all, those Insects are again generated from these Animalcules, though in a Manner altogether secret, and unknown to us.—One more Instance to elucidate this *mysterious Generation* of Animalcules in Water must suffice.—The Mucilaginous Matter which you see upon the Surface of the Leaves, and all about the Sides of the Pan you see here, is a sudden adventitious thing, and is certainly the *Spawn* of some invisible Insects, containing their Eggs, from whence proceed such Myriads of Animalcules, as make those greenish yellow Tufts that almost cover the Surface of the Water in the Pan.—I shall put some into the Concave for you to View in the Microscope.

Euphros. I see what you mean very plainly, *Cleonicus*.—From the Mucous Matter on the Edges of the Leaf, I see thousands of fine slender capillary Animalcules proceed.—I see they are all in Motion, though exceeding slowly, this way and that, to the right and to the left.—I see they are transparent—their Bodies of a perfect polish with small Specks or Spots at equal Distances through the whole.—Others detached from the Leaf.—I observe progressive Motion forwards, though so very slow, that I can but just perceive it.—Some seem broke into Pieces, which Pieces, also, I observe move forward—and sometimes backwards—
—but

—but what I am amazed at is, that I can see no Way or Means by which they move.—There are no Parts belonging to the Body, and the Figure and Direction of the Body suffer no alteration.—Pray what Length do these Animalcules grow to, *Cleonicus*?

Cleon. I have not yet been able to ascertain that Point—but you'll observe they soon spread themselves all over the Surface of the Water, and form a *thick Tissue* thereon.—Several of these I have taken of upon Plates of Glass, at times, which appear of a beautiful Azure Hue.—The *Gracility*, or smallness of these Animals in regard to their Length, I believe exceeds any thing we find in Nature besides;—A *Human Hair* covers twelve of them; which shews, they are not more than about $\frac{1}{3600}$ Part of an Inch in Diameter.—But you will sometimes see them extend themselves at least five or six Inches in Length, which is twenty thousand times their Width.—I have many curious Specimens on Glass, framed and gilt, to decorate the Museum of my *Euphrosyne*, who will then be able to shew what can no where else be seen.

D I A L O G U E X.

SPECULATIONS *on the* amazing CONNECTION of
INSECTS *and* SHELL-FISH; *exemplified in the*
CRAB-LIKE INSECT, *and the* LOBSTER-REPTILE.
Also some REFLECTIONS *on the* Death-Watch
INSECT.

Cleonicus.

NOTWITHSTANDING, my *Euphrosyne*, that I have endeavoured to entertain you more than once with the Contemplation of these egregious Specimens of Nature's peculiar Operation in those Species of Beings which we may consider rather as *Compound*, than Simple; rather as *two Natures* united in a *Third*, than as an individual Species; yet this most curious Subject is so far

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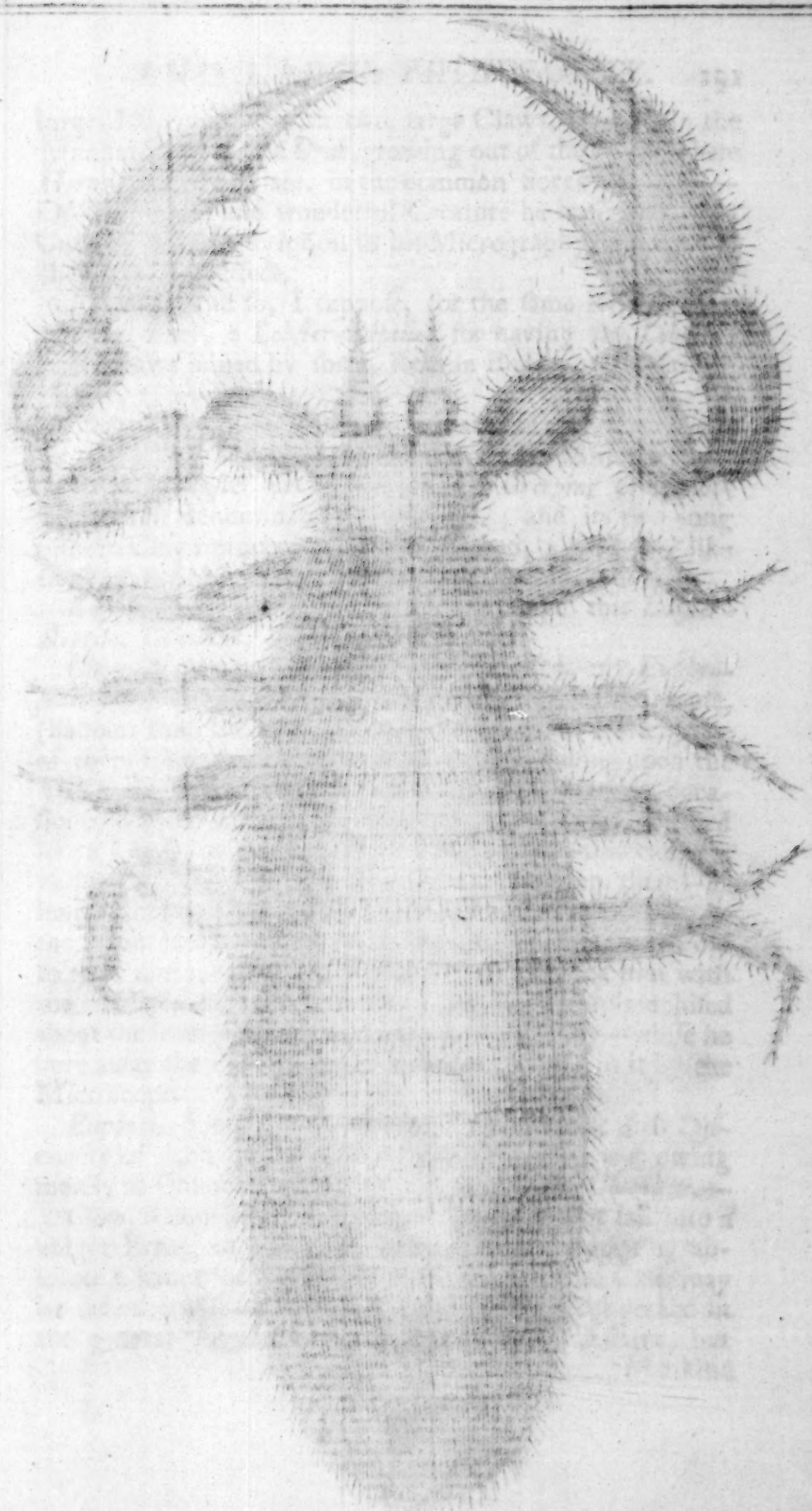
from being exhausted, that with my *Euphrosyne's* leave, I intend to employ one Hour more upon the same, especially as two of the most extraordinary Instances of this Duplicate Nature in Animals yet remain, which, with their Novelty and exquisite Construction of Parts, cannot fail to afford the most sensible Delight to a Person of her delicate turn of Mind.

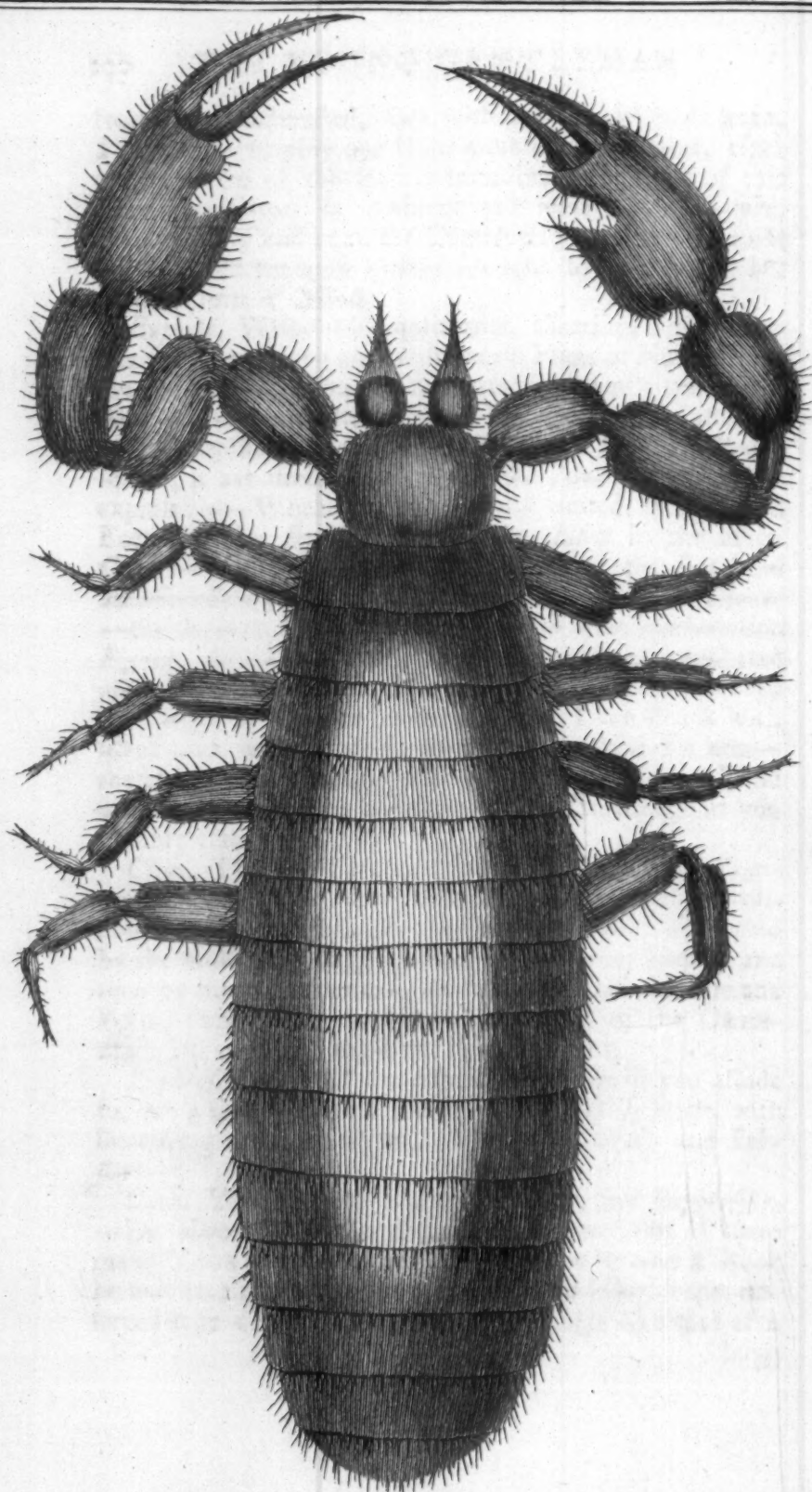
Euphros. Without Compliments, *Cleonicus*, I must confess that the plainest and most simple Plans of Nature have always appeared to me full of Perfection, and attractive of Admiration—but when at times I have met with Instances of a Complication, or Union of *different Species of Beings in One*, it has affected me beyond the Power of Words to express:—When I reflect on the united Nature and Forms of the *Quadrupede* and the *Insect* in the *Mole-Cricket*—of the *Quadrupede* and *Bird*, in the *Bat*, and *American Squirrel*—of the *Quadrupede* and *Fish* in the *Beaver*—the *Surinam Eel* with *two Feet*—*Fish* with *mathematical Figures*, &c.—I say, when I reflect on these complicated and extraordinary Productions of Nature, they shew me the Finger of God so evidently, that I am struck with silent awe, and the most profound veneration for him—therefore, pray *Cleonicus* proceed, to replenish my Mind with as much of this singularly divine Knowledge as you possibly can.

Cleon. The two Specimens of Creatures of this Compound Form, are very small indeed, which is undoubtedly the Reason why they have never been discovered by the most inquisitive Naturalists, 'till very lately; and then by mere Accident.—According to their Nature and Form, they go by the compound Names of the *CRABLIKE-INSECT*, and the *LOBSTER-REPTILE*.

Euphros. By this I understand the Animals you allude to, are a Connection of the *Insect* and *Reptile* Race, with something in the *Shell-Fish* Species of *Crabs* and *Labsters*.

Cleon. You meet the Idea very exactly, my *Euphrosyne*,—*Dr. HOOKE* was the first who discovered one of them many Years ago, as it was creeping slowly over a Book he was reading, and placing it under his Microscope, observed it to consist of a Body very much like that of a large





large *Mite*, armed with two large Claws, exactly in the Manner of those of a *Crab*, growing out of the Head, where *Horns*, and *Feelers* are, in the common Sort of Insects.—Of this novel and wonderful Creature he has given us a Cut and short Description in his *Micrography*, but both of them very imperfect.

Euphros. And so, I suppose, for the same Reason, you call the other, a *Lobster-Reptile*, for having the *Lobster's* large Claws joined by some Reptile Body, or something like it, *Cleonicus*.—

Cleon. Your Conjecture is not amiss, my *Euphrosyne*; for though its Body be not in Form of a Mite, or properly of any Insect, yet its Motion is by *Creeping* or *Crawling*, which denominates it a *Reptile*; and its two long jointed Claws proceeding from its Head, a good deal like those of a *Lobster*; whence the Propriety of its Name.

Euphros. And pray, who first discovered this *Lobster-Reptile*, *Cleonicus*, and when?

Cleon. Not more than a Year has elapsed, my *Euphrosyne*, since some labouring Men sitting in a public House, (happier than their Prince over their Pots of Porter) one of them spied this small Animal crawling along upon the Table, and thought it of an unusual Form—this occasioned a nicer Inspection; and they thought it appeared like a Louse, with unusual long Horns;—this caused a variety of Opinions and so a Debate between them—at length they appealed to an ingenious Gentleman, then in the Room to decide the Affair between them—this he did to their mutual satisfaction; and they rewarded him with the Insect for his good Office.—They sat and philosophised about the strange Phænomenon, in their Way—while he bore away the Prize to make new Discoveries in it by the Microscope.

Euphros. From this Narration I observe the first Discovery of each of these singular Animalcules was owing merely to Chance, as most Things are indeed, *Cleonicus*.—

Cleon. I question if my *Euphrosyne* does not fall into a vulgar Error, in supposing many Things happen by absolute Chance or Accident, when possibly the Case may be far otherwise—*Providence* is undoubtedly concerned in the general Administration of sublunary Affairs; but

Mankind have no Concern in the *Privy Council* of Heaven—they see and know nothing of its Springs and Movements; nor of its Dispensations relative to the Subjects of Arts, Sciences, and Manufactures, which are well known to be gradual and progressive, imparted to Mankind by divine Direction, tho' by unsuspected Means oftentimes, and are therefore thought casual—thus in the present Case, a poor Mechanic was the first Discoverer of, perhaps, one of the greatest Curiosities in the World; and the most irrefragable Argument of Omnipotent Power and infinite Wisdom, that ever *Theology* could boast.

Euphros. Though *Cleonicus* be not a Clergyman, yet I perceive he can comment upon a Subject pretty notably, when he is minded so to do.—But to the Point; please to oblige me with a short Account of each of these new discovered Objects.

Cleon. I shall do more than that, my *Euphrosyne*, I shall give you a Sight of them severally—one of which is alive, the other dead.—It fortunately happened this Morning that I called on a Gentleman, who is much of a Virtuoso, and he told me with great complacency, that he could pleasure me with a View of Dr. HOOKE's *Crab-like Insect*, which he happened to have by him alive—I viewed it with Admiration, and in much greater Perfection than the Doctor himself ever saw it—I satisfied my own Curiosity, and then begged the Favor of taking it home for an Hour or two, to gratify your's.—He very politely desired I would—

*For when a Lady's in the Case,
You know all other Things give place.*

Euphros. I think you took great Liberty with your Friend for my Sake—but as you have got it, pray let me see it immediately.—

Cleon. Have Patience, my *Euphrosyne*—it requires some delicacy to place it nicely to your View—there, now look at it as long as you please, and tell me what you see?

Euphros. See! why I see what Dr. Hooke properly calls it—a *Crab-like Insect*, sure enough :—The Body is shaped something like that of a *Mite*, with a Head, Breast, and Belly all united, and tapering to a Point at the

the Snout—in the Head I observe two Black Eyes—but what most of all strikes me, are the two large Claws growing from either Side, like those of a *Crab* precisely—they consist each of four Joints with as many Articulations—at the End of the Claws are two long *Pincers*, which the Animalcule can open and shut at Pleasure, I see.—These Claws are almost as long as the Body of the Creature — the *Head* is covered with one *Scaly Shell* — the *Breast* or *Thorax*, with two smooth circular Shells, or Rings—and the Belly with eight such Rings, with little Knobs and Protuberances—but I see nothing like *Wings* upon it—and, lastly, I see four Legs of a Side; and thus I think I have surveyed the whole of this great Singularity, *Cleonicus*.

Cleon. Nearly so, my *Euphrosyne*; you have only omitted to take Notice of the two *Forceps*, one on each Side the Mouth, into which they convey the Food which they receive from the Claws—but the great Curiosity of this Animal, not only my *Euphrosyne*, but even the Doctor's piercing Eye, passed by unnoticed.

Euphros. For goodness Sake, what can that be, *Cleonicus*?

Cleon. Take one more View of it, Sister; and let it be as critical as you can.—

Euphros. I will—but for my Life I can see nothing more than I did before—I see the Body, the Rings, the Legs, the Claws, the Pincers, and even the Hairs upon them—and what is there more that you can see, and I can't, *Cleonicus*?

Cleon. Nothing, my *Euphrosyne*—for take one more philosophic View, and you'll be within a Hair's Breadth of discovering what I mean.

Euphros. Well, now for the utmost *Fort of Sight*—I suspect from what you say, that this great Mystery must lie in the Hair—I shall reconnoitre them very minutely.—Oh! I begin to descry the Thing—I see a *Motion in the Hairs*, *Cleonicus*, is not that, after all, what you mean?

Cleon. It is indeed, my *Euphrosyne*—this is entirely a new *Phænomenon*.—Pray look attentively at them once more—and tell me how they move.—

Euphros. I will, *Cleonicus*—they move in a most singular

lar and amazing Manner, It is a voluntary and independent Motion—some bending this Way, some that, and some another, according to the Will of the Creature—in short, the Motion of each Hair is in every Direction—I don't know that I ever saw the like Motion of the Hairs in any other Animal, not even the Claws of the Crab itself.

Cleon. I believe the Proprietor of this Insect was the first of all Mankind that was favoured with this Discovery—how wonderful must be the fine System of Muscles, that give the *Hairs* such universal Motion and Direction! How curious is the Articulation of each Hair which moves, as it were, by *Ball and Socket*!—How exquisite must be their Sense of Feeling!—For undoubtedly the Use of these Hairs is the same as the *Antennæ* or *Feelers* in common Insects—by these they find out the Particles of Dust, &c. that are proper for their Food—the Particles they take in the *Pincers*, convey them to the *Forceps*, and from thence to the Mouth as I said before.

Euphros. Well, I think I have been highly entertained indeed—pray make my grateful Compliments to the Gentleman, and let him know how much I felicitate him on his new *Discovery of muscular Motion* in even Hairs of the minutest Creatures; and how much he has obliged me by the Sight of it—a Happiness which the *Empress of all the Russias*, I imagine, has not enjoyed, and which *Solomon* himself never dream't of!—but as I have seen all I can see of this, you will now please to oblige me with a Sight of the *Lobster-like Reptile*, you mentioned, *Cleonicus*.

Cleon. That I shall do, my *Euphrosyne*, having borrowed it for the same Purpose, of the Gentleman who had it at the Public House, and who expressed great Pleasure in having it in his Power to delight your Curiosity therewith—It is, dead, indeed; but still, all but the Motion may be seen—the Form of the Creature is the Novelty and Peculiarity of it—It has no *Compeer* in Nature that we know of—even that *Crab-Insect* that you speculated but now, has no more Resemblance to it, than a *Crab* has to a *Lobster*.—I have placed it under the Glass, in a fine Point of View, look at it.——

Euphros.

Euphros. I see the whole of it perfectly—I notice the Body and the Claws—they are much different from what I saw in the former.—The Body of this is long, and it's Sides parallel, not rounding to a Point, as in that—It has twelve or thirteen Rings about the Body; and the other had but eight—the *Thorax* is also somewhat different—and the Head very much so—for here I see nothing like Eyes—only two circular convex Pieces on the fore Part, which I know not what to make of—but for the Horns or Claws, though equally jointed and articulated, they are still widely different in Form and Parts from the others—the Pincers are not exactly like the other—have rather a greater Quantity of Hairs than they, and, I suppose, when alive, they served to the same Purpose.

Cleon. I think you have very minutely and accurately surveyed it, my *Euphrosyne*—but in Order to shew the Eyes, it must be turned upon the Back, and then you'll see them plain enough—each Eye exactly under the circular Canopy you mentioned but now—there, now it is turned, look at it.—

Euphros. Oh, I see the Eyes very plainly, and all their Checquer-Work—I imagine those large *Umbrella's* have their Use, if we knew it—I see now also the nice Insertion of the Claws in the Head, and of the four Legs on each Side into the Breast—upon the whole, I think this the most marvellous Creature of the two—though both of them great Curiosities indeed.

Cleon. So great, my *Euphrosyne*, that, were I a Person of Fortune, I should disdain to think one hundred Guineas an Equivalent for one of them, especially the latter, which I esteem the more curious of the two—but *Æsop's Dung-bill-Cock* occurs to my Mind, who, when he had scratched up a *Diamond*, says, what is this *Precious Stone* to me? I had rather I had found a *Barly Corn*.

Euphros. How few are the Fortunate, in respect either of Wealth or Wisdom!—But there is one Animal, cule of this almost invisible Tribe, that has made itself very famous by a particular Noise that it makes, which resembles in some measure the *Beating of a Watch*, and of which the common People have a Sort of dreadful Idea,
and

and call it a *Death-Watch*; pray, *Cleonicus*, tell me what it is, and what is the Meaning of such an unusual Note?

Cleon. I should have described this to you in another Place, but forgot it.—This celebrated Insect is much oftener heard than seen—this Insect is nearly the Size of a common Louse—of an Oblong flattish Figure—of a pale brownish White Colour—runs very nimbly, like a common Book-Louse—is frequently among old Wood, Furniture, in the Chinces of Wainscot, &c.—it feeds on the Dust of powdered Bread, Fruits, &c. but not of Earth, as is manifest from their Care and Curiosity in hunting after it.—

Euphros. But, *Cleonicus*, what do you say about that dismal solemn Note of his, which People think *presages Death* to some of the Family?

Cleon. Say, my *Euphrosyne*—why I say it is one of the many Impostures made Use of to deceive, delude, and intimidate the Credulous silly Populace—so far are the Notes from being *dismal Presages* of Death, that they are, like those of the *Cuckoo*, just the contrary, *Notes of Love*, and *Presages of Hymeneal Intercourses*—by these the Males and Females woo and court each other, at proper Seasons—for Love is a *mutual and universal Passion*, as Mrs. ROWE has most elegantly expressed it in the following Lines.

Spirit of Nature, it's informing Soul!
Thou dost the Powers of Heaven and Earth controul;
All the Degrees of Life and Sense that rise,
In Fields, or Floods, or through the spacious Skies,
All feel the Force of thy inspiring Flame,
And joy and triumph in thy mighty Name.

THE

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART IV.
CONTAINING
A General SURVEY of VEGETATION and VEGETABLES.

DIALOGUE I.
*Of Vegetable LIFE, and OECONOMY ; and the
ORIGIN of PLANTS from SEED, explained by
EXPERIMENTS.*

Cleonicus.
DESCEND we now, my *Euphrosyne*, from the higher Scenes of *Animal Life*, to Objects of a much inferior Order, which though they are said to *live*, yet this Life is only of a *Vegetative Nature*, and, properly, *no Life* at all.

Euphros. My dear *Cleonicus* will point out to me, in very few Words, the Difference between *Animal and Vegetative Life*.

Cleon. The Life of Animals consists in three Things, *Mind, Sensation, and Growth*, as we have seen ; but the Life of a *Vegetable* consists in *Growth* only ; though Custom has made it usual to call this *Power of Growing*, the
Life

Life and even, the *Soul* of a Plant.—Every Plant is originally an Organized Body in Miniature, that is, it consists of various determinate Parts, which have this vegetative Power by Nature, of unfolding themselves, from a certain fixed Point or Basis, downwards into the *Earth*, and upwards into the *Air*.—By this divine Power, the *Descending Part* is gradually unravelled, protruded, extended, and carried forwards in numberless Branches and Ramifications, through the circumjacent Parts of the resisting Earth, Stones, Rocks, &c. to the most Filamentary State—and this Assemblage of Parts is called the *Root* of the Plant.—But the ascending Part consists of much greater Variety, and is, in short, the whole Substance of the Plant in Miniature.—By this vegetative Power in the Earth, all the several Parts in the *Plantule* evolve and unfold themselves by imperceptible Degrees, till at length they are separated one from another, and begin to open the Earth, and appear above Ground, in the proper and specific Forms of the Parts, which we call *Leaves*, *Blades*, *Stalks*, *Stems*, *Branches*, *Flowers*, *Seeds*, &c. composing the adult Plant.

Euphros. I collect from what you say, and from what I see every Day in the Garden, that this Plantule is originally contained in that Part called the *Seed*; because it is necessary to deposit in the Earth the Seeds of every Kind of Plant you would raise there.

Cleon. In this you are perfectly right, my *Euphrosyne*.—Every Seed contains in itself the whole Plant in Miniature which produced it.—This Plantule is placed by the Author of Nature in the Side of each Seed; and as each consists of two Parts, called *Lobes*, it is included between, and connected with both, on the Side where they join.—The whole Affair of *Vegetation* is exquisitely epitomized by the late Dr. BROOME in the following Lines.—

*Thus in the Kernel's intricate Disguise,
In Miniature a little Orchard lies;
The fib'rous Labyrinths by just Degrees
Stretch their swoln Cells, replete with future Trees;
By Time evol'd, the spreading Branches rise,
Yield their rich Fruits, and shoot into the Skies.*

Euphros.

Euphros. Very pretty indeed.—But you are as positive and particular in the Account of this Plantule in the Seed, as if you had really seen it there, *Cleonicus*.—

Cleon. Seen it there, yes, that I have many a time; and so may *Euphrosyne* too, whenever she pleases

Euphros. Such a Sight would of all things delight me; and therefore I beg *Cleonicus* would oblige me with it.

Cleon. I am prepared to answer your Request, my *Euphrosyne*, by having steeped some large *Windsor Beans* in Water, for that very Purpose.—One of the largest of these you see I strip of its Shuck or Coat, and then the two Lobes of the Bean appear turgid and ready to separate.—I now open them, and at the Juncture by the Side, pray what do you see, my *Euphrosyne*?

Euphros. 'Tis so small I must view it with my Explorer Lens.—Dear me, I see the *infant Plant* you speak of.—I see a Leaf or two, very distinctly—the very Ribs and Traits in the Leaves—I see the pointed Tops of several Leaves—nay, I see the very Stalk of the Bean at bottom, or something very much like it.—

Cleon. And though you see the *Germ*, or Embryo-Bean so satisfactorily in this Case, my *Euphrosyne*, yet there is another Subject that will exhibit to your View a more compleat and convincing Instance of the Existence of the future Plant in its Miniature State in the Seed:—There it is, view with your Lens the great Beauty.

Euphros. A great Beauty, indeed, *Cleonicus*,—why it is a perfect little Tree—the Leaves are numerous and distinct, lie over each other, and rise one above another—not only so, but there is a neat well proportioned Body to the Tree—in short, it is in itself the very Picture of a compleat Plant.—Pray what do you call this Seed, *Cleonicus*?

Cleon. The *Nux Vomica*; it is produced by an Indian Shrub called the *Arborescent Night-shade*, and is a most violent Poison; therefore take Heed how you bite or taste it.—With these Precautions I shall leave it with you, for an excellent Object in your *Opnke Solar Microscope*.

Euphros. I thank you, *Cleonicus*, for so valuable an Object; I shall preserve it very carefully.—But pray let me ask you,
if

if this Infant Plant does not receive Support and nourishment from these two Lobes including it, when first put into the Earth?

Cleon. It does, my *Euphrosyne*; and there are particular Vessels appropriated to that Use, as are discovered by anatomizing the Lobes.—It is a Case nearly similar to the young *Embryo-Fowl*, who lives upon the Contents of the Egg till it is able to break the Shell, and shift for itself.—So the Embryo Plant is sustained by Nutrition from the Lobes of the Seed, till it is able to strike its Roots downwards into the Earth, and draw its Nourishment from thence.

Euphros. What you say seems confirmed by what I have often observed of these Seed-Lobes myself, and that is, that in many Plants, particularly *Kidney-Beans*, they rise out of the Earth with the young Plant itself; but always appear thin, shrunk, and in a sort of exhausted State, as if all its natural Substance had been spent on the inclosed Plantule.

Cleon. Your Observation is exceedingly just and pertinent, my *Euphrosyne*.—And now we are to contemplate on the Means which Nature has ordained for the *Vegetation* or Growth of this young rising Plant through all its Stages to Maturity.—I have heretofore observed to you that a Plant, though insensible, is yet an *Organized Body*; and consists of a *System of proper Vessels for circulating Fluids of different Kinds, through its whole Substance*.

Euphros. I well remember the Experiment by which you shewed this grand Point to be fact; and that was by shewing on the Air-Pump, that a Piece of Wood was perfectly pervious to Air, Mercury, &c. which I saw passed with the utmost Freedom through it lengthwise.—This, *Cleonicus*, proves the justness of the Definition you have given me of a *Vegetable Body*.

Cleon. The DIVINE OECONOMY of the *Circulation of Fluids* through the *Body of the Plant* is every way as incomprehensible to us, as that in the *Body of Animals*; but the Mechanical Principle, or Means employed for that Purpose, is obvious to us, and that is, *By the Natural Power of Attraction between the Particles of Matter in Bodies*.—But then it must be also considered, that this
attracting

attracting Force does not affect all the Particles of Matter *equally*; because, if it did, there could be *no Motion*; since a Particle urged every way equally, can move no Way, but must necessarily remain at *rest*.—These are *Axioms* evident to common Sense, and want no other Proof.—When, therefore we see the Particles of Matter move, we must conclude they are affected by Forces greater on one Part than on the other, which is the Cause of that Motion.

Euphros. On my Word, *Cleonicus*, you have represented this Motion so clearly, that I am very certain I see a positive Demonstration of it every Morning in my *Tea-Dish*—for no sooner do I put in the Piece of Sugar, than the Fluid at the Bottom of the Cup runs immediately up into it, and wets it quite to the Top, and then dissolves it.

Cleon. You could not have mentioned any thing more *Apropos*, my *Euphrosyne*.—The Particles of Fluids being so free to move, shew they have Figures nearly spherical or round; and that their attractive Powers on each other are less than those of any Bodies upon them.—And thus the Sugar, the Sponge, the Filtre, &c. applied to them, attract and draw them up into their Substance.—But what is most to our Purpose is a set of *Capillary Tubes*, which I have provided to give you a proper Illustration on this Head.—They have unequal Bores, you see; and when I place them in a Jar of Water, they all attract the Water above the common Level; but it rises highest in the Tube of the smallest Bore.

Euphros. I see it does; and I suppose *Cleonicus* will infer from thence, that if the Bores were to decrease, the Height to which they would raise the Fluid, would increase, till at length this Height might exceed any one proposed.

Cleon. You have spoke all my Mind at once, my *Euphrosyne*.—Now then, supposing a Plant to consist of an Assemblage of an indefinite Number of such Capillary Tubes or Vessels, where will be the Difficulty of conceiving that they might together raise a Fluid to a Height greater than that of any Tree whatever, and consequently, those Capillary Vessels in the Roots may by their united attracting Power on the moist and fluid Particles of the Earth,

Earth, draw and collect a sufficient Quantity thereof to rise and circulate from thence through the Trunk, and all the upper Parts of the Plant.

Euphros. This seems to be a very Natural Idea of Vegetation; so far at least, as fine attracting Tubes and Vessels are concerned.—'Tis evident to Sense, that such Attraction exists in *Capillaries of Glass*, and it is highly consistent with Reason and Analogy to believe the same thing in similar Parts of Vegetables.

Cleon. But sound genuine Philosophy admits of no Dependence on *Believing*, but on experimental Proofs and Facts alone.—By these my *Euphrosyne* must be convinced of the Truth of the afore-mentioned Point.—For this Purpose, see here two *Capillary Siphons*, one in *Glass*, the other a *Vegetable* one; both of equal Length and Bigness.—They will each of them be immersed with their shorter Legs into this Wine-Glass half filled with Water—they are at present full of Air, but, as soon as immersed, the Attracting Power of the Siphon, will act upon the Water, draw it up into the Tube, carry it over the curved Part, descending from thence through the longer Leg, it drops into the Plate below.—But this Motion of the Fluid through the Tube is so rapid, that unless your Eye be fixed on the Glass Siphon the moment I immerse it, you will not perceive it.—There, now look.—

Euphros. Oh, I see the whole Operation very perfectly, how sudden the Rise and Descent! how equable the Distillation in Drops! how wonderfully expressive of the Power of Attraction in the *Glass-Capillary*!

Cleon. In the next Place you are to see the same Effect produced by the *Vegetable Siphon*.—You observe I no sooner immerse it, but it begins and continues to drop, as the other does—the *Glass Siphon* performs this Work by the Attraction of one small Pipe or Tube only, the *Vegetable Siphon* works by means of thousands bound up together.—Of whatever Substance the Siphon is made, the Effect will still be the same, for all *Filtres*, draw off Water in the same Manner, and from the same Cause.—

Euphros. I don't see how 'tis possible to have a greater or more direct Proof, that the *Fluid Parts of the Earth are drawn up into the Bodies of Plants, by an Attractive Power with*

with which they are naturally endowed.—I have but one Difficulty more I (think) to get over, *Cleonicus*, and that is, how this Fluid in the Earth gets into the Extremities of the Roots, and what becomes of it after it is raised up into the Body and Branches of the Plant?

Cleon. As to the Manner in which the Particles of Moisture in the Earth get into the Roots, it is by infinite Numbers of Pores, too small to be subject to our *obtuse Senses*.—And as to what becomes of it afterward, we shall see more particularly in pursuing our Enquiries of this kind, at our next Conversation.

DIALOGUE II.

Of the VEGETATION and CIRCULATION of the SAP in Plants; and the ORGANIZATION, and VESSELS, of which they consist; illustrated by Microscopic EXPERIMENTS.

Cleonicus.

THE last time I had the Pleasure of expounding experimentally the Operations of Nature in regard to the Principles of the *Vegetable Oeconomy*, I satisfied my *Euphrosyne*, that it chiefly consisted in raising Fluid Particles from the Earth into the Bodies of Plants for their Vegetation or Growth.—These Nutricious Juices, we call the SAP of the PLANT.

Euphros. I apprehend by your Manner of Speaking, that the *Solid Parts* of the Earth, or what we generally call the EARTH, has but little to do in the Composition of the Sap, but how far may it be concerned therein, *Cleonicus*?

Cleon. This is a Question hard to resolve my *Euphrosyne*; such Parts of the Earth as are resolvable into a Fluid, may be absorbed by the Root, as all Kinds of Salts, for Instance.—But for real Parts of Earth, which are but small transparent Pebbles, there is no Proof that I know of, or

think conclusive, for their entering into the Pores, or making any Part of the Substance of the Sap.

Euphras. Indeed I observe as much from *common Experience*.—For all my Plants and Flowers in *Pots*, grow from small to great, and from Year to Year, by the *Addition of Water only* in a due Degree.—The Earth seeming only a Sort of Basis or Foundation for the Support of the Plant, and a Medium for receiving and communicating all kinds of *Alimentary Juices* thereto.

Cleon. Your Observation is very just, my *Euphrosyne*; the Body of the Earth is the Medium by which all manner of Substances that can be liquified, and are derivable from *Earth, Water, or Air*, are communicated to Plants for their Vegetation, according to their different Species. Thus the *Sap* of Plants may be considered as a most *heterogenous* Substance, consisting of *Water, Oil, Salts, Sulphur, Rosins, Gums*, and Juices of a thousand different kinds, which give them all the various *Odours, Sapours*, and *Powers* to affect us in an infinity of Ways—by which some are Food for Animals in general—some for the *Human Species* only—and most of them *Medicines* for all Disorders and Complaints.—In short, Vegetables, and their Virgin Mould, constitute an universal Covering to the rocky Globe, and bedeck it with all the *variegated Verdure*, we see every where around us.

Euphras. Pray *Cleonicus* does the Sap continue rising in Vegetables all the Year long?

Cleon. If the Plant be of that Sort called *Annual*, or which die in the Course of the *Year*, as most Herbs and Flower Plants do, then the Sap is considered as rising in them only from the Time they begin to vegetate, or put up their Heads above Ground, to the Time of their *adult or mature State*, and some little time after, till the *Flowers* are blown, and the *Fruit* ripened; when the Plant decays and dies; and shews the Circulation of the Sap at an End.—If the Plants be of the *Biennial* kind, or such as continue alive *two Years*; then they vegetate or rise to their full Growth the first Year; and in the second, they bloom, and bring forth their Fruits and Seeds; and die away by Degrees.—But those Plants properly called *Shrubs* and *Trees* live many Years, and

and the *Vegetable Oeconomy* in them is very different from what we observe in *Annual Plants*.

Euphros. I observe, *Cleonicus*, a real difference in the Structure of the Stalk of an *Annual Plant*, and the Stem or Body of a Tree.—One is generally a mere *Case*, either *hollow*, or filled with a *Pith*;—whereas that of a Shrub or Tree, is woody and hard, and has little, and some no Pith at all.

Cleon. The Stalks of Annual Plants consist of only one Case or Shell of Air and Sap Vessels, which is sufficient for the *Life of one Year*; these Vessels are most firmly connected and compacted together, and inclosed by a common Rind or Skin with a Tunicle over that, so that the whole together gives Firmness and Stability to the Plant, which can thereby stand its Ground against all the violence of Weather.

Euphros. Pray *Cleonicus*, what is the *Use of the Pith* in Plants?

Cleon. Indeed, Sister, you have asked a Question that I cannot answer.—An Use there may be, but what I never could find—for I have deprived Young Shoots of Elder of their large Piths, and they appeared to vegetate equally well without them.—This I know, that the Texture of Pith is exceeding curious; and *Transverse Sections* of Pithy Annuals make some of the most delightful Objects for the Microscope, as you will soon be convinced of, by a select Number placed in these Sliders ready for your View when at leisure.

Euphros. Pray what *Microscopic Views* do the Sections of the *Roots* of Plants afford?

Cleon. Very few that are fine—amongst these the finest of all that I have met with, is the Section of the Root of *Fern*.—In this there is seen the most beautiful Disposition of Air and Sap-Vessels the Eye can behold.—And such a singular Tinge of a nobler Yellow than Gold itself can boast of.—Plenty of these also you will find in the Sliders adapted to your *Opake Solar Microscope*.

Euphros. I shall attend to them, at my first leisure very minutely.—You was saying, *Cleonicus*, that the Vegetation of *Trees* differs from that of *Annual Plants* very considerably; please to inform me in what Respects.

Cleon. I will, my *Euphrosyne*; First, in regard to the *Stem* or *Trunk*.—Secondly, in respect to the *Covering* or *Bark*—and Thirdly, in respect to the Period of Time it continues, which is a Number of Years, more or less.—As to the *Stem*, it vegetates in two Respects, growing to a certain *Height* and *Bigness* the first Year, and divides on the Top into Twigs, and Leaves.—The second Year it vegetates in Height and Bulk again, with more small Limbs and Leaves than before.—And after this Manner, the Tree annually becomes large in Bulk, and tall as the *CEDAR in Lebanon*.—But the Limit or Period of encreasing in Height is much less than that of encreasing in Bulk, which latter is scarcely known to Mortals.—For it continues Years, if not Ages, after the inner Part of the Tree is wasted and rotted away, as we often see in the old enormous Shells of Oak, Elm, Chesnut, and other Trees.

Euphros. Pray, *Cleonicus*, to what Degree of Magnitude have Trees been known to arrive?

Cleon. To a Degree almost incredible, my *Euphrosyne*; upon the Side of Mount *Etna*, there remains the lower Part of the Trunk of a *Chesnut* Tree, which measures two hundred Feet in Circumference, and of Course is upwards of sixty Feet in Diameter; it is undoubtedly the largest in the known World, and no Man living remembers it much otherwise than at present it appears.—This hollow Shell of a Tree is looked upon almost as great a Curiosity as the *Volcano* itself.

Euphros. An amazing Bulk, indeed!—Your second Observation was in regard to the *Bark* of Trees, pray what is particular in the Vegetation of that Part?

Cleon. Something very extraordinary indeed; my *Euphrosyne* will wonder, perhaps, to hear it said, that the *Bark* of a Tree, in its first year's Growth, contains in *Miniature* the whole future Bulk of the Trunk or Body of the Tree.—Yet this is not more strange, nor less true, than that the whole Tree itself was once contained in a small Seed.

Euphros. This latter Mystery you elucidated by Experiment; and can you bring the other to the same Test, *Cleonicus*?

Cleon.

Cleon. I doubt not but I can, to your Satisfaction my *Euphrosyne*.—You will know then, that the Bark of every Tree consists of two Parts, the *Internal* and the *External*.—This you evidently see in cutting transversely this thick Piece of the Bark of *Dutch Elm*.

Euphros. I do; I observe the *Internal Part* has a very different Appearance from the *External*, which seems to have nothing at all regular in its Texture, while the *Internal Part* is exquisitely so.

Cleon. This Interior Part is the very *Essence* of the Tree, and contains the Rudiments of all its future Substance, as I shall now demonstrate by Experiments.—Another Slip of the same Bark of *Elm*, has been prepared by Maceration, and by that Means it becomes separable into a Number of very thin *Laminae*, like Pieces of Ribbon or Tape of the same width—this I have brought with me for your Ocular Conviction, my *Euphrosyne*, that the inner Part of the Bark, consists of an indefinite Number of *fine thin concentric Cylindric Shells or Cases* of a lignous or woody Substance, and which are easily separable by Art, and much more so by Nature.

Euphros. I see by the prepared Specimen all that *Cleonicus* intends.—I tell eighteen or twenty of these *Laminae* as you call them, in this Piece of Bark, and there seem to be more yet not separated —But pray what do you infer from hence, *Cleonicus*?

Cleon. I infer this—That every Year of the Tree's Growth, the inmost of these thin Shells is separated, by a reflux Sap, from the rest; and by slow Degrees vegetates into a Cylindric Case of Wood, which at last adheres very strongly to the Body of the Tree, and thus encreases its Bulk for that Year.

Euphros. This seems a very plausible Inference; but is this also capable of Proof by a direct Experiment?

Cleon. Nothing easier, *Euphrosyne*.—It is only to be understood, that the Sap rises all the Year long through the Body of the Tree, and returns at one Season very copiously between the Body and the Bark, which is the Beginning of Spring.—To shew this reflux Sap to the Eye, I shall go with you into the Garden, and cut out a

broad Slip of Bark from a *Fir Tree*.—I no sooner do this, than you see the *returning Sap descend in Drops from the upper Part of the Incision*, but none appears on the lower Part.

Euphras. An Experiment this beyond the Power of Contradiction.—I see the Drops distil, what can I see more?—I see none rise from below.—Well, now proceed to your next observation, *Cleonicus*.

Cleon. This refluent Sap produces a continual Vegetation of the interior Case of the Bark, and gradually converts it into a Substance of Wood, which then appears of the same Nature and texture with the other Wood of the Tree; and this being the Case Year after Year, you easily understand the Tree must become annually larger and taller by the continual Accession of these Shells or Cylinders of Wood.—But as this is a Capital Article in Vegetation, I shall give you an Experimental Proof thereof likewise.—You see here a Piece of a Bough cut off from a Poplar Tree—while the Bough was whole, a Part of the Bark was taken off quite round the Bough, about a quarter of an Inch wide—the Wood was left quite bare, and soon became dry on the outside—After a few Days, the Sap returning from the extreme Parts of the Bough, fell upon the Incision and swelled it out all around, while the other Part of the Incision next the Body of the Tree, appeared to have no Sap at all to affect it.—In about ten or twelve Days, the Parts of the Incision, above and below joined in a Sort of callous Protuberance all round, as you here observe it.—The Bough remained thus upon the Tree till the beginning of Winter,—when I cut it off, and splitting it through the Middle, every thing I expected from this Experiment was obvious to my View immediately, and so it must be to yours, my *Euphrasine*.

Euphras. But you know better what you see than I do *Cleonicus*.—I see the two Surfaces of the Piece of Wood thus split, but what am I to learn in particular from them?

Cleon. All that I Design at present to charge your Mind with, in regard to the Vegetation of Shrubs and Trees in general, and that is, *that the Body of the Tree grows bigger every Year, by the Accession of an hollow Cylinder of Wood,*
derived.

derived from the internal Part of the Bark: And this in the Experiment is what you cannot help seeing:—For, first, there is the Wood of the Bough, in the Middle Part, without any *increase of it's Bulk*, and looks as if it were dry, the Bark does not touch it—again, in the second Place, there is a *cylindric Shell of Wood*, which appears on the Inside of the Bark, near $\frac{1}{10}$ of an Inch thick;—thirdly, this Shell is evidently Wood, and alone by itself in the Bark, in that Part where it does not touch the Bough;—fourthly, in all other Parts, this Shell joins to the Wood of the foregoing Year; both above and below the Incision; and thus makes the Wood of the Bough of the present Year, at least $\frac{1}{5}$ of an Inch bigger than the Wood of the Year before, as you see by comparing each—and what would you see, or wish to know more, my *Euphrosyne*?

Euphros. I do not know that this great Principle can possibly be made plainer—I see with the greatest Satisfaction, every particular you mentioned, really existing in the Bough, and therefore in Nature itself.—I see, and am strictly convinced the *general Theory of Vegetation* as you have here laid it down, is in every respect just and true.

Cleon. These two Pieces of Wood tally exactly, as they have been only split asunder, they are kept together by a Silver Ferrel, and put into this Shagreen Case, as a great and uncommon Curiosity for your Museum, to be inspected upon Occasion, by any one curious in these Things, who may at any Time happen to be a Party in the philosophical Conversation of your *Tea-table*.

DIALOGUE III.

Of the BARK and WOOD of Timber TREES; and the PARTS and CONTEXTURE of each; the Growth, Size and Age of TREES. Microscopic VIEWS of their Air and Sap VESSELS.

Cleonicus.

I Observed to my *Euphrosyne*, at our last Interview, that the Bark of Trees consisted of two Parts, the

internal and the external, the former we have already considered in a general Way; and now I shall observe to you two or three particularities of the latter or external Bark.—This is called the *Cortex*, or common Covering of the Tree, which is usually, in large Trees, very thick and hard, and seems designed as a Defence of the internal essential Part, from the injuries of *Weather*, &c.

Euphros. Pray, *Cleonicus*, of what Sort of Substance does this outward Bark consist?

Cleon. 'Tis hard to say what the Substance of any thing is, my *Euphrosyne*.—In some particular Barks, the Texture may be discovered, but in none so directly and eminently as in that of the *CORK-TREE*, so called, because it is this outward cortical Bark, that is the real *CORK* we use in stopping our Bottles, and in all other Branches of that extensive *Manufactory*.

Euphros. Say you so, *Cleonicus*; well, I was so wise that I never knew what Cork was before—I almost wish to see such an Oddity as the *Cork-Tree*.

Cleon. That you may do at any Time in *Chelsea-Gardens*; but what will be more to your Purpose, will be to examine the Wood as well as the Bark of the Tree, which you may do very well in this Piece of a Limb of that Tree I have with me for that Purpose.

Euphros. This Piece presents to my View all I can wish to see—the Difference between the two Parts of the Bark, is here evident enough—the outer Part looks like what it is, *Cork* sure enough—but the Wood of the Limb seems to be very compact, and hard.

Cleon. And so it is in reality, my *Euphrosyne*, so hard that it is difficult to cut any thin Slices from it for microscopic Views—it is reckoned a Species of Oak.—There is great plenty of it in *Spain*, &c. and the Trees extremely large.

Euphros. I need not trouble you any further on this Head, because my Microscope has many a Time informed me of the vesicular Substance and Texture of Cork, cut either Way.

Cleon. I shall finish with only one Observation more, and that is, by cutting it into very thin Slices, it appears
to

to be exceedingly *electrical*, a Property not taken Notice of by our common *Historians of Nature*, that I know of.

Euphros. Well worth Notice, indeed! as that extraordinary Power is, wherever it appears.—But pray, *Cleonicus*, now we are on the Subject of Barks, what Part of the Pant is that we call *Flax* and *Hemp*?

Cleon. These important Subjects are nothing more than the *Rind* of Plants of the same Names, properly manufactured by Art.—The *Rinds*, or vegetable Coverings of *Annual Plants* are found to consist chiefly of *long, slender Filaments*, discernable by the Microscope, constructed and supported by other Kinds of Substance, called *Parenchyma*—but the said *Rinds* being taken off, well dried, and beaten with a Bittle, become thereby divested of all the Skin and parenchymous Part, and appear in proper Form—these seem to be *solid Filaments*, and therefore exceeding strong, and fitted for all the Purposes we apply them to, in the *Linen and Rope Manufactories*—and as by this Means we are furnished with the most delicate Part of our Cloathing, our Bed and Table Linen; so most Nations in hotter Climates get the same Conveniences from the internal Bark of Trees, which Nature seems to have supplied them with to that End—what do you think of these several Pieces of different Stuff, which I now spread out before you, my *Euphrosyne*?

Euphros. Why really, if I had seen them accidentally, I should have taken them for so many Pieces of common Linen or Woollen Cloth—but by what you have been saying, I should guess they are some Kind of Cloth of Nature's own manufacturing.—

Cleon. You are very right, my *Euphrosyne*; they are such Sort of Cloth, as is woven in Nature's own Loom—not a *warp and woof Texture*, but Layers over Layers, Planes upon Planes, of a filamentary Substance, capable of being unravelled, and expanded to an amazing Degree—see here a Piece in particular, my *Euphrosyne*, large enough to make you a Handkerchief to wear about your Neck and Shoulders; as thin, fine, light and cool as any *Gauze* you have.

Euphros. I never saw any thing like this before!—every thing you say of it, is true—I think our finest Linen of a far inferior

inferior Nature. — And is this the inner Bark of a Tree, *Cleonicus*?

Cleon. Indeed it is; and to convince you of it, I here put into your Hand, a Stick of the Wood itself, with the Bark upon it, brought from *Otaheite* by Captain Cook, with many other Curiosities of the Kind.

Euphros. This is a curious Affair, indeed, *Cleonicus*; I see the Bark contains that very fine Linen in a close compacted State—and this I suppose to be the Case of all the other large Pieces which you are so obliging as to give me.

Cleon. It is so; for they are severally the interior Bark of very large Trees, with which their Forests abound—From a Tree two or three Feet in Diameter, they take such Quantities of this Sort of Linen, as serves them for *Mattresses* to lie on; for *Sheeting* or *Blankets* to cover them; and a finer Sort yet for *Garments*—and what is very observable, they are by this Means furnished with very good *Paper to write upon*, if they did but know how, as you see by this Specimen here, in a fair Hand.

Euphros. I shall very carefully examine them all at my leisure, *Cleonicus*, as they will afford me the highest Amusement.

Cleon. I shall now place this internal Bark of Trees in another point of View—that in which it appears after Nature has elaborated it to the last Degree, and brought it in the course of Years, to a perfect State of Wood in the Trunks of Trees—and in Order that you might have the most compleat Idea of the Manner in which they appear in this lignous State, I have procured a Piece to be cut transversely out of the Body of a tall Fir, and well planed on each Side, so that the *Ringlets*, or Sections of the several cylindric Shells, may very distinctly appear—see, there it is, my *Euphrosyne*.

Euphros. Oh, perfectly distinct, indeed;—this Section of the Fir, is an Index of its Age, for I number forty-three *Rings of Wood* from the Pith in the Centre to the Bark on the outside, and therefore am convinced it is forty-three Years old.

Cleon. You must be right, my *Euphrosyne*—and if it had stood ten Years longer, there would have been fifty-three
Rings

Rings of Wood; and so on, for the whole Age or Life of the Tree:—I have chosen the Fir for this Experiment, because the Yellow Turpentine filling the Vessels at each conjuncture of the Rings, render them much more conspicuous to the Eye:—Here is another Piece of the same Fir split down through the Middle, which gives you a View of them length-ways.

Euphros. You take great Pains, *Cleonicus*, to give me the compleatest Information of every Thing. Pray let me ask you one Question; is it possible by Art to separate those Shells of Wood one from another, so as to take them off, one after another?

Cleon. I do not know that this is possible by Art, but I know, it is by Nature, to whom, indeed nothing is impossible;—it proves lucky for my *Euphrosyne*, that I once accidentally found a decayed Stump of Elder, so thoroughly macerated, soaked, and loosened in its Texture, that I found several of those lignous Shells of that hard Wood already separated to my Hand—I took them off very carefully, and placing them properly together, you see they compose Part of the Body of that Stem of Elder to which they belonged when alive.—

Euphros. I do indeed, see the very Body of the Stem resolved into its constituent Shells, a Sight I should never have expected.—

Cleon. I have told my *Euphrosyne* more than once, that these lignous Shells are only an infinite Number of Sap and Air Vessels bound firmly together through their whole Length.—What now remains, is to shew that this also is fact, by the plainest Experiments:—for this Purpose, nothing answers so well as that Sort of Rotten Wood we find in a decayed *Elm*, when it has been thoroughly macerated by Rain and Weather—I have procured some prime Pieces, to give you the best Views of these essential Matters;—I first break one Piece short asunder, and now apply your Glass to view the Orifices of the Vessels, in their native Appearance, my *Euphrosyne*.

Euphros. I do, with wonderful Pleasure view them all; nothing can appear more natural and distinct; far beyond what the nicest Cuttings with a Knife can produce.

Cleon. We will now take them in another View, my *Euphrosyne*;

Euphrosyne; and that is, as they lie *Length-ways in the Wood*—for this Purpose I break the Piece of rotten Elm afunder *Length-ways*, and you immediately see the most natural Appearance of the *Vessels*, as they exist in the Shell, and of the *Ligaments* or Bandages, by which they are all bound and kept together, lying *cross-ways* over them.

Euphros. I see by the Eye alone what you describe, *Cleonicus*; but when I apply the Magnifyer, dear me, how perfectly I see the long cylindric *Vessels*, and the *Ligaments* lying over them at right Angles!

Cleon. There is only one more View in which I can place these *Vessels*, and that is the most perfect, and the last of all—These *Vessels* in this rotten Wood are individually separable from each, so that you may view a System of them singly, with their transverse *Ligaments*, all as a *transparent Object* in the Microscope, or an *Opake one*, as required—I have flistered off several, and placed them in Sliders for your View.——

Euphros. This is the whole Affair truly—I see the *Vessels* now all transparent, like so many *Gloss Capillaires*—can see plainly enough, that they are long, slender Pipes—I can even see that each single Tube or Pipe consists of long Fibres also, though so very small as to be but just perceptible.

Cleon. And I believe now, my *Euphrosyne*, you have seen all that I can shew you, except one particular only.—It has been generally asserted by Botanic Writers, that the Air *Vessels* in Plants are made up of *spiral Filaments*, the contrary of which you have just now seen.—There are indeed in many Plants, these vegetable Spirals to be seen, but then they are coiled round the *Vessels* in those Plants, and do not constitute *Vessels* of themselves;—this I shall shew you in a *Vine Leaf*:—You see I break the Stalk of the Leaf, and lay the two Pieces with the fractured Part, under the compound Microscope, where you will see several of these Spirals if you look, my *Euphrosyne*.

Euphros. I do, and see them very plainly—they are like a *Bottle-screw*—there are some drawn out almost strait—some quite coiled up, as it were in Form of a spiral Tube.——

Cleon.

Cleon. But now in the last Place, I must observe to you, that these are only by the Fracture forced off from the Vessels about which they are actually coiled in the Stalk itself—to prove this, I take off a Piece of the Stalk *Length-ways*, and then, not only the Air Vessels appear, but the *Spirals* about them at the same Time through their whole Length—I have placed them under the Magnifier, for your View, my *Euphrosyne*.

Euphros. Nothing can be more evident and distinct—I see many of those Vessels or Pipes, and Spirals about them all—pray, *Cleonicus*, what is the Use of these Spirals to the Plant?

Cleon. I confess I do not know, my *Euphrosyne*—they appear *transparent*, but whether they are *hollow or solid Filaments*, I cannot take upon me to say; and, of course, cannot be certain of their Use.—Having thus explained the Texture and Construction of Wood in general, it only remains that I provide my *Euphrosyne* with a Choice Collection of *transverse Sections* from most of the Trees, Shrubs, and Plants of our own Climate, and also many from foreign Parts.

DIALOGUE IV.

Of the LEAVES of PLANTS and TREES, their curious ORGANIZATION and PARTS, explained by Anatomizing them, for microscopic INSPECTION. Their SKINS; double SYSTEM of ARTERIES and VEINS; and GLANDS for PERSPIRATION; how they PURIFY the AIR.

Cleonicus.

THE next great Work of Nature in Vegetation, is the annual Production of LEAVES in Plants and Trees. These, my *Euphrosyne*, deserve our utmost Attention in an Explication of their Nature, Construction, and Uses; all which will be best understood by a Dissection
or

or Anatomy of them, by a proper Maceration in soft Water.—For when we have seen the several Parts of which the Leaves consist, we shall be better enabled to judge of their Uses.

Euphros. And pray, what is the Process of anatomizing these Leaves, *Cleonicus*? Is it such as I can understand?

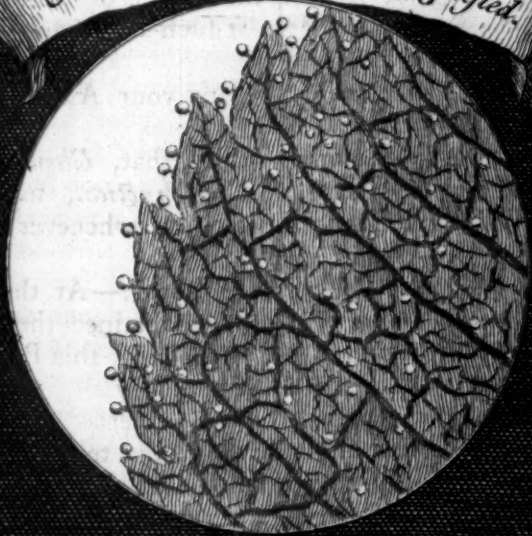
Cleon. Yes, and practise it too, for your Amusement, every Year of your Life.

Euphros. I am glad to hear you say that, *Cleonicus*; I should be glad to have a little of the *Practical*, together with the *speculative* Part of Philosophy, whenever Opportunity offers.

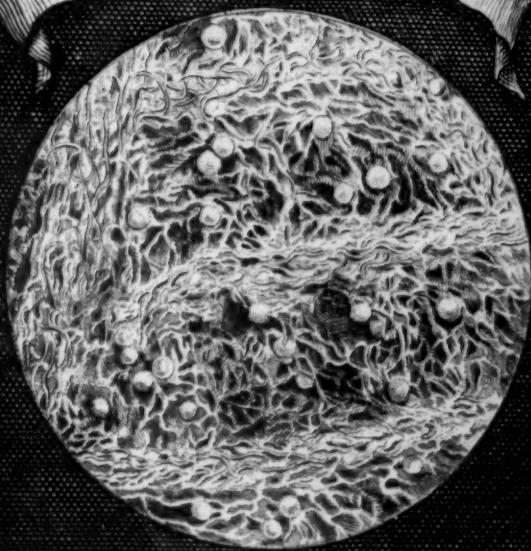
Cleon. The Process I use, is as follows:—At the Beginning of *August*, when *Leaves* have obtained their full Growth and mature State, I gather them for this Purpose—those of the *Poplar Tree*, and particularly of that Species called the *Aspen Trees*, I find by Experience answer for Dissection the best of all others;—about ten or twelve of these I put into a Pan of *Rain Water*, about an Inch deep, and let them stand in a Place where the Sun can shine upon them every Day, as many Hours as possible—by this *Insolation*, the Leaves will soon become soft and macerated to a sufficient Degree, that is, in about twelve or fourteen Days—then I put each Leaf in another Pan of Water, a little warmed, and patting them gently between the Thumb and Fingers, the Skin of the Leaf will on each Side become loosened, and may be easily taken off in large Pieces, which I take up upon Slips of Glass, and lay them by till they are dry, for *microscopic Views*.—All the Green Substance of the Leaf, flows out, and diffuses it through the whole Body of the Water, but at length subsides, and settles in Form of a *Green Powder*; and is that called the *parenchymous Substance* of the Leaf;—lastly, the ligenous Substance of the Leaf is then left bare and naked, consisting of the *Spine* along the Middle; with numerous *lateral Branches*; which are again subdivided into a multitude of Ramifications, Fibres, &c. indefinitely—this *Woody Skeleton* of the Leaf I take out of the Water upon a Piece of Writing Paper put under it; and so lay it by till it is dry.

Euphros.

Sweet Brier Leaf, Magnified.



Sage Leaf, Magnified.



Euphros. Well, in all this Analysis of the Leaf, I see nothing but what I can very well perform myself, *Cleonicus*, and will attempt it the first Opportunity.

Cleon. Why should you not, my *Euphrosyne*? I do assure you that one of the finest Skeletons of Leaves that I shall by and by shew you, was made and given me by one of your fair Sex—but as the Leaf appears to be a Subject of the highest Consequence in Vegetation, and a perfectly organized Body, it will be proper to examine and take a most perfect View of its several Parts by the Microscope, the most compleat *Expositor* of Nature—and I place under you Eye a Piece of the Skin of a Poplar Leaf, look well at it.——

Euphros. I see it perfectly well——a fine transparent Membrane it is—I observe in it all the *Lineaments and Traces* of the several *Ribs and Ramifications* of the Skeleton, so nicely impressed, as to shew the very single Fibres—but what strikes my Eye most of all, is the curious Appearance of the *dimpled Surface* of the Inside of the Skin—it looks like fine Lattice-Work—an infinity of irregular transparent Cells—in these, I suppose the *Green Particles* of the Leaf are deposited, between the two Skins.——

Cleon. That is the very Thing I wished you to observe, my *Euphrosyne*; these Green Bodies you here see, in another Specimen of the Skin, do exactly and uniformly fill these Cells.

Euphros. I see they do—but how much larger the Cells appear here than they did in the other Leaf, pray what Leaf is this the Skin of, *Cleonicus*?

Cleon. Of an Oak Leaf, my *Euphrosyne*, I chose that for your View, as I know of no other Leaf so fit for giving you a proper Idea of those important Particles, by Means of their large Cells which contain them, in respect of their Figure, Magnitude, and connection with the Extremities of the ligneous Fibres.——In the last Place, I here lay before you a great Variety of Skeletons of Leaves, which at Times I have anatomized, that you may see the Construction is much the same in them all, only the Fibres and Ramifications in some are much finer than in others.——

Euphros. A beautiful Variety, indeed.——I can tell what most of the n are by the Figure—this is an *Aspen Leaf*—

Leaf—that is an *Elm Leaf*—that, an *Ivy Leaf*—and that, of *Holly*—besides a Multitude of others.—But I observe something very remarkable in one or two of the *Holly Leaves*, and that is, that they are *split into two*, and appear *Double*.

Cleon. This *Phænomenon* of a *Duplicature* or *double System of Vessels* in the *Leaf*, is the *Foundation* of all our *Reasoning* upon the *Nature* and *Use* of this great *Organ of Vegetation* in *Plants*—And by what you see in the *Holly Leaves* it appears, that one *System* of these *Vessels* is very fine and full of *Ramifications*, like the *System of Arteries* in *Animal Bodies*—while the other is only a thinner and coarser *System*, in this *Respect* too, like the *Veins* in *Animals*.—In many *Leaves* this *Difference* of the *Systems* of *Vegetable Arteries* and *Veins* in the *Leaves*, is not any thing like so much.—You see here several *Elm-Leaves* with every *Fibre* double throughout the whole, but with little apparent *Difference*.—And in some of the *ever-greens*, you observe there is no *Difference* at all.

Euphros. All this I see very distinctly in the several *Sorts of Leaves* before me.—And now pray what do you conclude from all these *Remarks* on the different *Parts of Leaves*?

Cleon. I am authorised from thence to assert, *That the Leaves of Plants and Trees constitute the grand Vegetable LABORATORY of Nature, for the performing all her Operations and Processes in the whole Oeconomy of Vegetation.—That when the Leaves begin to appear, a Circulation of the Sap also through them, appears along with them.—That this Circulation encreases with the Leaves, and continues vigorously while the Leaves are in Vigour.—But declines, and at last ceases, when the Leaves fade and fall off.*

Euphros. According to this *Account of Vegetable Circulation*, I suppose I am to understand that the *Sap* is brought from the *Trunk, Limbs, Boughs, Branches, and Twigs* of the *Tree*, into the *Substance* of the *Leaves* by *Means* of that *System of Arterial Vessels*, we observe in the *Skeleton* of the *Leaf*.—Is not this the *Case*, *Cleonicus*?

Cleon. Indeed it is, my *Euphrosyne*;—then the *Green Particles* of the *Leaf* being in the *Nature* of *Glands*, with *recipient* and *excretory Ducts*, receive the *Sap* from the *Arteries*

Arteries which it prepares and elaborates for the Nourishment of every Part now pullulating and vegetating in *Buds, Gems, Blossoms, Flowers, Fruit, and Seeds*.—After this Operation of these vegetable Glands, the Sap is received by the Extremities of the System of Veins, and carried from the Leaf to the Inside Bark of the Body, Boughs, and every Part of the Tree or Plant that appears, or is to appear, during the Season of Circulation.—The useless Part of the Sap is carried off by the excretory Ducts, and perspires through imperceptible Pores in the Skin.—This perspirable Fluid may be collected into a Phial, by putting the Leaves of a small Twig into it, and properly covering it.—It appears in Form of a *pure, clear limpid Water*.

Euphros. Well, so much for the Circulation of the Sap, *Cleonicus*.—Pray inform me next how the Air-Vessels perform their Office in this great Elaboratory of the Leaves?

Cleon. Before I can do this, I must acquaint you with one thing, and that is, that the *Principle and Soul* of Vegetation consists of an Inflammable Spirit in the Air, such as is well known to be produced by a *Fermentation* resulting from all decayed, rotten, and putrid Substances of every kind, both Animal and Vegetable.—That such *Putrifaction*, and consequently, *Inflammable Air*, abounds more copiously in the Summer time; and very little in the Winter.—That this Inflammable Air is very pernicious to Animals—And hence when the Air begins to be thus infected, the Circulation begins also in Vegetables, and the Green Leaves cover the Trees.—Then it is, that the Air Vessels begin their Office likewise, by receiving and circulating this impregnated Air—separating and straining it through the Glandulous Substance of the Leaves—retaining the Inflammable Spirit for the Nutrient of the Plant.—And then the remaining Air now rendered *pure*, is discharged by Pores on the under Side of the Leaves to mix with the common *Atmospherical Air*.—Consequently this Air is by Means of this *Vegetable Laboratory* rendered more pure and wholesome for *Animal Respiration*, during all the hot Summer Season.

Euphros. Pray by what Experiment is this salubrious

Air breathed from Trees and Plants made visible to us, *Cleonicus?*

Cleon. Among many other Ways, one is to put a Quantity of Leaves fresh gathered into a tall Glass Jar; then filling the Jar with Water just taken from the Pump, it is inverted into a Vessel of the same Water, and placed in the Sun for the whole Day.—Then will the Air in the Leaves ouze out through the Pores, and rise up to the upper Part of the Jar, where it will appear above the Water, and in a few Hours time, in a large Quantity.—From one hundred Leaves of *Nasturtium* more than half a Pint of this departed Air was obtained in six or eight Hours.—It is said, that from some Sort of Leaves and Substances this Air may be obtained so extremely pure, that an Animal will live four or five times as long in it as in Common Air.—And it is certain, that a Candle burns in it with so *brilliant a Flame* that it dazzles the Eyes to look at it.—With some of these Experiments I intend e're long, to entertain my *Euphrosyne*, by an Instrument lately discovered, and fitted by very nice Mechanism for all such Purposes.—

DIALOGUE V.

Of the FLOWERS of PLANTS; of the PARTS of a perfect FLOWER, Of the EMPALEMENT or CUP; The PETALS, or LEAVES; The Stamina, or CHIVES; Their Apices and the Farina, or DUST; The STYLE; the SEED-CASE, and the SEED; The FRUIT.

Cleonicus.

WE are now, my *Euphrosyne* arrived to that Province of Nature which abounds in an infinite Variety of *Flowery Scenes*, and *fragrant Avenues*, so delightful to the View, and so grateful to all our Senses.—I have always looked upon FLOWERS, as the most glorious and
gayest

gayest Effect of Omnipotent Power in the Vegetable Order of Beings—as the *Pride* and *Beauty* of the Creation.

Euphros. I think every one must View them in the Light you do, *Cleonicus*.—Who can justly paint the Flower in its highest Bloom, either by Pen or Pencil? Who can imitate the Colours of the *Carnation*, *Tulip*, *Auricula*, by Art? And though we attempt it, we can only show how vastly superior Nature is to Art, and how far above Imitation.

Cleon. Very true, my *Euphrosyne*; but still the Painter should be indulged, while his Performances are considered only as Imitations.—Since good Flower-Pieces, Landscapes, &c. may be viewed as *Nature at Second Hand*.—POETS are ravished and fired with this Theme in all their Writings and Descriptions.—GARTH has given us a beautiful Picture of the Spring, teeming with *rising Flowers*, in the following Lines.——

*Within the Chambers of the Globe they spy
The Beds where sleeping Vegetables lie;
Till the glad Summons of a genial Ray
Unbinds the Glebe, and calls them out to Day.
Hence Pancies trick themselves in various Hue,
And hence Jonquils derive their fragrant Dew:
Hence the Carnation and the bashful Rose,
Their Virgin Blushes to the Morn disclose:
Hence the chaste Lily rises to the Light,
Unveils her snowy Breast, and charms the Sight:
Hence Arbors are with twining Greens array'd,
T' oblige complaining Lovers with their Shade,*

Euphros. These are Sentimental Touches, indeed; to which I think may be added, the following Moral Reflections of PRIOR, viz.

*Along the sunny Bank, or Wat'ry Mead,
Ten thousand Stalks their various Blossoms spread:
Peaceful and lowly in their native Soil,
They neither know to spin, nor care to toil,*

Yet with confess'd Magnificence deride
 Our vile Attire, and impotence of Pride,
 The Cowslip smiles, in brighter Yellow blows
 Than that which on the Bridegroom's Vestment flows,
 Take but the humblest Lily of the Field,
 And, if our Pride will to our Reason yield,
 It must by sure Comparison be shewn,
 That on the Regal Seat, great David's Son,
 Array'd in all his Robes and Types of Power,
 Shines with less Glory than that single Flow'r.

—But, pray *Cleonicus*, what are the several Parts that constitute a *Compleat* or *Perfect* FLOWER? For I see so great a Variety in the make and Composition of Flowers, that I know not how to judge of their respective Degrees of Perfection.

Cleon. A *Compleat* FLOWER always consists of the following Parts.—(1.) The *Empalement* or Cup.—(2.) The Blossom with one or more *Petals* or *Leaves*.—(3.) The *Threads* or *Chives*.—(4.) The *Apices* or *Tips* which grow on the Tops of the Chives.—(5.) The Seed-Bud with the *Style* above, and sometimes a *Shaft* or *Pedicle* below.—In many Flowers, one or more of these Parts are wanting; but the *Chives*, or *Seed-Bud*, or both, are found in all, as they are the *essential Parts* of the Plant, and its Flower.

Euphros. I presume, from what you say, that the *Empalement* of Flowers consists in those *Outside Green Leaves* which enclose the Flower in the Bud, as in the *Rose-Buds*, &c.

Cleon. That is the most conspicuous *Empalement* you could have mentioned.—In many Flowers, it consists of only one Funnel-like Cup, as in *Polyanthuses*, *Auriculas*, &c.—In Corn and Grass, it is called the *Husk*—In the Willow, Filbert, &c. it makes the *Catkins*.—In all Cases, the Use of it is to defend and Support the young tender Flower while in its Blooming State.—But in Flowers that are very robust, you see no *Empalement* at all, as in the *Tulip*, *Crown Imperial*, *Lily*, &c.

Euphros. The *PETALS* or *LEAVES* of the Flower, I suppose *Cleonicus*, serve for circulating and meliorating the Sap for the Use of the several Parts of the Flower, Fruit, and

and *Seed*, and to qualify the Air also for that and such like Purposes.

Cleon. Your Supposition seems very just, my *Euphrosyne*. But the Action of the Leaves upon the Air in Flowers, seem quite different from that of the Common Leaves of the Tree, which perspire a *fine Salubrious Air*, but the Leaves of Flowers, on the contrary, breath a very unhealthy and infected Air, pernicious to Animal Respiration, as has been found by numberless Experiments tried with it.—Such is the strange and singular Nature of Flowers, that while they ravish our Sight with all the inexpressible Beauties of Colouring, and Fragrance of Smells, they contaminate the Air we are breathing at the same time through our Nostrils.—Remember this, my *Euphrosyne*, when you sing to your *Lyric-hord*,

*What Beauties does Flora disclose!
How Sweet are her Smiles upon Tweed! &c.*

Euphros. Upon my Word, *Cleonicus*, you are enough to put one out of Conceit of a *Flower Garden*.—I used to think it a *Paradise*,—but now if I smell to a *Nossegay*, 'tis at the hazzard of my Life, I find!

Cleon. The Air which Flowers diffuse through the Garden is bad enough, 'tis true, but don't let us make the worst of it, my *Euphrosyne*; consider, it is immediately mixed with the Atmospheric Air all around, and therefore cannot in such small Quantities, and in such open Space, affect any Person sensibly to his Prejudice.

Euphros. Indeed, *Cleonicus*, I am not so timid, but that I shall wear the *Rose*, and the *Passion Flower* to decorate my Bosom—but pray to what Uses do those *Chives* serve, which I see in the interior Part of the Flower?

Cleon. They are an *essential Part*, because the *Tips* which grow on the Tops of those slender Threads, are Vessels, which contain the *Farina*, or *prolific Dust* of the Plant—this is the immediate Organ of Fertilization in the Seeds of Plants—where this Dust is wanting to fertilize the Seed, such seed will never produce a Plant.

Euphros. Since this Dust is of such Importance, I

should be glad to have a more particular View of it through the Microscope, if you please, *Cleonicus*.

Cleon. That you shall, my *Euphrosyne*; I have put one of those Tips just taken from a *Sun flower*, under your View, look at it.—

Euphros. I see a great Number of small Yellow Balls in each Side of the Tip, which is open on both Sides—I see also the Surface of the Tip almost covered with them—those upon the Concave are extremely pretty, being *spiculated* all around—they are perfectly *globular*, and of a fine *Yellow transparency*:—Pray, *Cleonicus*, what may these Balls be composed of?

Cleon. They contain a most subtile, pellucid, oleageous *Fluid*, or *Spirit*; as easily appears by bruising some of them on the Glass—as you now may see.—

Euphros. I do see some whole, and some bruised or broken—from the broken ones, I see a Fluid has issued, and besmeared the Glass—I see it is also of an *oily Nature*, as it lies in *Streaks*, and sticks in *Patches* to the Glass—I am satisfied it is a *Fluid* they contain.

Cleon. As I know you are very curious, I shall shew you these Balls in another Light—I place a Drop of Water in the Middle of the Concave, and shaking a little of the Dust over it, some will fall into, and some out of the Water; and then you will observe what *Phænomena* will thence arise—but your Eye must be fixed upon the Drop, when I throw on the *Farina*.—

Euphros. I have now the Drop of Water in View—you may put on the Dust, *Cleonicus*.—Oh, I see it wonderfully plain—that which falls in the Water is greatly swoln—I see several of the Balls in the Water burst very quickly, in every Part of the Drop—each Ball I see discharge an infinite Quantity of something, but I do not know what—they are not Particles of fine Dust, because they are pellucid, and of a round Figure—what must I call it, *Cleonicus*?

Cleon. It is the oily Spirit in the Balls bursting out in Myriads of little Globules, which will not mix with the Water.—This is the true Spirit of the Plant that fertilises the Seed—but let us next see the various Methods which Nature takes for that Purpose—the most generally places
the

the *Chives* and *Seed Bud* both in one Flower, which therefore is *always fertile*—but sometimes she places the *Chives* in one Flower, and the *Seed-Bud* in another, upon the same Stalk or Bind, as in the *Cucumber*, &c.—sometimes all the Flowers on one Stalk have *Chives*, and all the Flowers of another have the *Seed-Buds*, as is the Case of *Hemp*, and many others.—Lastly, the *Chives* sometimes are in all the Blossoms of one Tree, and the *Seed-Buds* on those of another Tree of the same Kind, as in the *Palm-Trees*—thus by some Means or other, the *Furina* of the *Chives* is carried from Flower to Flower, from Plant to Plant, and from Tree to Tree, to fecundate or fertilise the Seed.

Euphof. But pray, *Cleonicus*, is it not this Yellow Dust of the *Chives*, that I see the Bees extract from Flowers, and load their Thighs with to carry Home to their Hives?

Cleon. It is, my *Euphrosyne*; and this they Work into a *Paste* by Means of the Oil it contains, and therewith build their COMBS to contain the Honey they get out of the *Honey-Cups* of the same Flowers—these Combs of the Bees are manufactured into *Wax* and *Candles*, by the *Wax-Chandlers*, to the prodigious Advantage of all Mankind, as they burn by this Oil or Spirit.

Euphof. As to the SEED-BUD, or SEED-VESSEL, and the STYLE above it, I observe they make no Figure 'till after the Bloom of the Plant is pretty well over—and then also the FRUIT begins to appear—but pray, *Cleonicus*, what am I to understand properly by the Word Fruit?

Cleon. The FRUIT of a Tree is that large beautiful Body that succeeds the Flower, and consists of a delicious ambrosial Pulp or *Parenchyma*, replete with nectarious Juices, which, when ripe, is so delightful to the Taste, to the Smell and to the Sight—these Juices are brought into the Fruit, and there sustained, by infinite Numbers of a Sort of *lymphatic Vessels*, which make the Bulk of the Fruit, and the whole is covered with a delicate Skin, often variegated and adorned with beautiful Blooms, Colours and Tinges of various Dyes.—The Pulp is the highest Luxury Nature affords to Mortals—and the ex-

pressed Juices make the richest WINES and LIQUORS for for *Drinking* that can be desired.—The finer Sort of Fruit, we call *Apricots, Nectarines, Peaches, Plumbs, &c.* have a central *Stone* including the Seed.—Other Species of Fruit, as *Apples, Pears, &c.* contain the Seed in softer Cases or Pips—while others, as *Grapes, Currants* and *Berries* of all Kinds, contain their Seeds in small hard Grains—and, sometimes the very Seed itself is esteemed Fruit, as *Filberts, Walnuts, Chesnuts, &c.*

Euphros. The SEED-BUD or SEED-CASE was the last Part of the Flower you mentioned, *Cleonicus*; pray what Particularities have you to rehearse of that?

Cleon. Some that are very considerable, my *Euphrosyne*—You know the common Forms of Seed-Cases in *Tulips, Lilies, &c.* when they stand to ripen—you also full well know those of all Sorts of PULSE, which are called their *Pods, Shells, or Shucks*, as in *Beans, Pease, Kidney-Beans, Vetches, Lupins, Gilly-Flowers, &c.*—many of these are *Esculent*, and make very nourishing Food.

Euphros. I have remarked a particular Part affixed to some Sort of Seeds like *fine Hairs or Down*, as in the *Thistle, Dandelion, &c.* pray, *Cleonicus*, is not this a wise Contrivance of Nature, to sow the Seeds upon the Earth by Means of the Wind?

Cleon. Undoubtedly it is, my *Euphrosyne*, they are called the *Feathers* of the Seeds, for that Reason, as they seem to *fly about* by the Wind.—Of all the Productions of Nature in the Vegetable Way, we meet with hardly any Thing so curious and beneficial to Mankind in general, as this very Article, the *Down of Plants*, which in a foreign Tree called *Gossypium*, is that very COTTON which makes so immense an Article of Commerce throughtout the World.—The *Flower* of the *Cotton-Tree* consists of five Petals, growing from the Basis, and is Heart-shaped on the Top—the Fruit is a round *Capsule*, containing four Cells, with a great Number of Oval Seed in each, and to each Seed is fixed this *downy Matter* or Cotton.—A Twig of this Tree, with several of those Capsules turgid with Cotton, I here present to my *Euphrosyne* for her *Museum*—this is called the *White wooly Cotton*—but there is another Sort produced by a Tree called *Xylon*, or the
prickly

prickly Cotton-Tree, which is of a *Silky Nature* and Colour, and grows in *Capsules* as large as a *Turkey's Egg*—one of these also, partly opened, I put into my *Euphrosyne's* Hand as a great Curiosity.

Euphros. You enrich my Mind and my Museum, equally, my dear *Cleonicus*.—I would only ask one Question more;—have you any Thing to add to what you have already told me of the Nature and Parts of the Seed?

Cleon. The SEED in all Plants, my *Euphrosyne*, is of the same Nature, Texture and component Parts; and vegetate alike, and from the same Principle in all.—The Seed is the *ultimate Produce*, yet *incipient Principle* of vegetative Nature; with which we began, and with which we shall End our present Conversation, with these few pertinent Lines from Mr. BAKER's Poem called the UNIVERSE, where, speaking of the *Seeds* of Plants, he says,

*Each Seed includes a Plant; that Plant again
Has other Seeds which other Plants contain:
Those other Plants have all their Seeds, and those
More Plants again successively inclose.
Thus every single Berry that we find,
Has, really, in itself whole Forests of its Kind,
Empire and Wealth one Acorn may dispense
By Fleets to sail a thousand Ages hence:
Each Myrtle-Seed includes a thousand Groves,
Where future Bards may warble forth their Loves.
So ADAM's Loins contain'd his large Posterity,
All People that have been, and all that e'er shall be.
Amazing Thought! what Mortal can conceive
Such wond'rous smallness!—yet we must believe
What Reason tells: For Reason's piercing Eye
Discerns those Truths our Senses can't descry.*

DIALOGUE VI.

REFLECTIONS *on the wonderful NATURE, and singular PROPERTIES of some Kinds of PLANTS, SHRUBS, and TREES; exemplified in MISSLTOE, SENSITIVE PLANT, BULBOUS GARLIC, BEE-ORCHIS, and EGG-PLANT.*

Cleonicus.

WE have now, my *Euphrosyne*, finished our Survey of the Process of Nature in forming the Bodies and Parts of all Kinds of Plants and Vegetables in the general Way: But you will always observe, in every Order of Beings, she is never perfectly uniform, but delights in Variety, Difference, and Variation, even from her most general Laws and Forms.

Euphros. This I have often adverted to, *Cleonicus*, in almost every Thing I see; and always with a serious Pleasure and Devoutness, as it appears to me a most convincing Argument, that a free, voluntary Agent is the Creator of all Things; for amidst such Order and Design, there cannot be the least Pretext for supposing they could possibly be the Effect of blind and undesigned Chance.

Cleon. You are extremely happy in the Inductions you make from physical Observations.—Nothing shews so evidently the Finger of the Deity in the Operation of Nature, as the many Instances we find of Deviations from established general Rules; and effecting the same Thing by many different Ways and Means, that we might be thoroughly convinced, *nothing is impossible to God*, though every Thing of this Sort be so by *Chance*, as you justly observe.—To shew this more particularly in *Plants* is the Employment, I propose for the present Hour.

Euphros. Well, what singularity of *Plants* do you propose to begin withal, *Cleonicus*?

Cleon. You will be soon apprized of the most extraordinary one in the whole Circle of Nature, my *Euphrosyne*.—It is said, *that God made every Tree to grow out of the Ground*

Ground—and this I believe is so general a Case, that I know of but *one Exception* to it, which is that particular Vegetable called MISTLETOE, which never could be made to grow out of the Ground (or Earth) by all the Art and Skill of all the Gardeners since Adam.

Euphros. Mistletoe! why I know what that is, as we garnish our House with it every Year, at *Christmas*.—It is an *Evergreen Plant*, with White Berries—I could never have thought of that Shrub being of so extraordinary a Nature.—Not grow out of the Ground! Why out of what does it grow, then, *Cleonicus*?

Cleon. Though it has not fallen yet in my *Euphrosyne's* Way to observe it, it's Nativity is of the greatest Notoriety, and indeed not a little admired by every *Clodpole* in the Country.—This is one among those Wonders in Nature, that passes unobserved, by being common.—You properly call it a *Shrub* or *Vegetable*, but very improperly a *Plant*, for it was never planted by the Hands of Man.—Nor has it any Root with Fibres to imbibe the Sap or Juices from the Earth as all Plants have.

Euphros. But how then is it produced *Cleonicus*? and by whom, or what?

Cleon. I will tell my *Euphrosyne*, without further Circumlocution.—The Generation of Mistletoe is on this wise—it bears very White Berries full of a viscous Juice and Seeds; these Berries are a delicious Food to many Sorts of Birds, and particularly so to one, called from thence, *The Mistletoe Bird*.—These Birds having eaten the Berries, they void the Seeds (unchanged in their Excrements) upon the Limbs and Boughs of many Sorts of Trees.—Here they lie till by their peculiar Nature and Power, they penetrate the Bark or Rind of the Tree, and begin to vegetate by means of its Sap.—After this, it begins to shew itself in form of a Bushy Shrub, adhering (as if by Inoculation) to the Wood or Limb of the Tree—growing into Limbs, Branches, and Leaves, in a Manner quite unusual to that of the Tree that fosters it, and indeed of any other of our Growth.—The Trees which nourish it, are principally the *Oak*, *Hazel*, *Plumb*, *Pear*, *Apple*, and (most frequently) *Crab Trees*.—[It's component Parts are *Bark* and *Wood*, with Pores like
other

other Wood ; but the Pores are small, and of course, the Wood very hard.—It is quite of the Ever Green Kind, though a *Nonpareil* in Nature.—In has a Sort of Blossom in May, from whence proceeds the Berries before-mentioned.—It is no wonder so odd and singular a *Phænomenon* as *Mistletoe* should have given Occasion to the DRUIDS (the *Priests* and *Legislators* of the Ancient Heathen *Britons* and *Gauls*) for imposing it upon the ignorant and superstitious Populace, as a Thing divine, and sacred to the Gods, who, they pretended, had endued it with miraculous Virtues for curing the most dire Diseases, as *Epilepsies*, *Aplexies*, *Palsies*, &c.

Euphros. Well, *Cleonicus*, you have raised in my Mind such an Idea of *Mistletoe* as I never expected.—I think so great an Oddity so little regarded, is an amazing thing.—It shews how little Use we make of those noble Faculties of Reason and Reflection ! But what do you find next of the marvelous among Plants, *Cleonicus* ?

Cleon. Something as anomalous and strange, as in the *Mistletoe*, my *Euphrosyne*.—And that is, in short, the *Sensitive Plant*.—I have already observed to you, that Plants have a *Vegetable Life* ; but *Vegetable Sense*, you never expected to be harranged with ; yet the few Specimens I here present you with, have very much the Appearance of such a Sensation.—And PRIOR makes no Scruple to ascribe Sense to it in the following Lines ;

*Whence does it happen, that the Plant which well
We name the Sensitive, should move and feel ?
Whence know her Leaves to answer her Command,
And with quick Horror fly th' approaching Hand ?*

Euphros. I am obliged to my dear *Cleonicus* for the Present, which I make no doubt is a very valuable one ; but I don't see any thing in these curious Plants like *Sense* or *Reason* yet.—

Cleon. Hold, my *Euphrosyne* ; I did not say any thing about their having Reason.—All I propose is to shew you they have an *apparent Sensation*, and that no other Species have the like—but see, a fine speckled Spider is crawling

crawling on one of them,——I must take it off, and shew you its Beauties in a nearer View.

Euphros. Pray *Cleonicus*, don't hold it so near me—I shrink at the very Sight of it.——

Cleon. I see you do—you clutch your Arms up, and draw back—that is the very thing you will see imitated by these Plants—but first observe their Structure—in each, a *Stock* or *Stem* rises from the Earth about an Inch, and then divides into several *Branches*—each Branch or Sprout produces several Pair of *Sprigs*, placed on each Side just opposite to each other at proper Distances from one another,——Every Sprig has Leaves of an oblong Form, placed also, upon a small Pedicle, just opposite to each another, in Pairs, through the whole Length.—Each Leaf has an Articulation in its Pedicle with the Sprig, like what the *Anatomists* call *Enarthrosis*, or *Ball and Socket*.——The Sprigs are also articulated into the Sprouts; and these again into the Stem.——Upon the whole, Nature has so wonderfully constructed this Plant, that every Part has the utmost Freedom of Motion, upon the Approach of any Object to it——To try the Experiment, put your Finger to one of the Leaves about the Middle of the Sprig——

Euphros. I will,——But Heavens, what do I see!—The Leaf I touched receded from my Finger—the Pair immediately closes up—as do all the rest above the Twig.——It not only seems to be *sensible*, but to have even *Life* and *Apprehension*.——This may well be called the *Sensible Plant*, *Cleonicus*.

Cleon. You see it shrinks from your Finger, as you yourself do from the Spider.——But as among *Animals*, some are more sensible than others, so among these Plants you will observe the same.——For now touch a Leaf on the Sprig of this Plant here.——

Euphros. I do—and observe instantly, that not only all the Leaves collapse and fall together on the Sprig, but that the Sprigs also close together in Pairs on the Branches, and even the Branches close upon the Stem.——So that all the whole Plant now appears almost of a *Cylindric* Form.—A most amazing and uncommon Sight, this!

Cleon. So sensible are these Plants (or rather so susceptible

tible of Motion) that even the *Effluvia* of strong-scented Oils, Smoke of Sulphur, the Beams of the Sun, &c. will make them close up their Leaves :—Though the Sensative Plant be so great a Rarity here, we are told by Voyagers, there are whole Woods of them in the *Isthmus* of *Panama* (in *America*) and that they make so great a Noise by the Rattling of their Leaves, as to be heard afar off.

Euphros. I thank my *Cleonicus* for so rare a Present ; and shall take every Opportunity of observing their Motions and Sensibility.—Pray what do you next observe amongst Nature's Deviations from her common Rules ?

Cleon. A particular Species of *Garlic*, in which we see something more like an *Inversion* of the Common Law of Vegetation, than a *Deviation* from it.—Look at the Specimen I have here brought you in a Pot.—

Euphros. I view it—but I see nothing in it different from a common, tall, full grown Onion ; except a Cluster, or rather a Bunch of *Bulbs* on the Top of the Stalk, and a few small Flowers which are the same as in other *Onions*, for ought I know.—

Cleon. And pray, my *Euphrosyne* what do you take these *Bulbs* to be ?

Euphros. Truly I should have thought these were the Fruit of the Plant, as they grow on the Top—but I confess they appear more in the Form of *Roots*, than *Fruit*—besides I know of no Fruit that *Onions* or *Garlic* bears—pray how am I to conceive of them *Cleonicus* ?

Cleon. Just as you said—that they are a Bunch of *Roots*—each Bunch consisting of such *Skins*, *Coats*, &c. as you see in the *Roots* of common *Onions*—each *Bulb* planted in the Ground, produces an *Onion* or *Garlic* as a common *Root* does.—This you will find true next Spring, when these six *Bulbs*, which you see me now set in the Earth, will arise therefrom in the Form of young *Onions* to make you a *Salad* of a very peculiar Nature.

Euphros. Well this is the first time, *Cleonicus*, that I ever heard of a Plant's having *Roots* both at *Bottom* and *Top*—or of bearing *Roots* instead of *Fruit*, in the extreme Parts.—Pray what other Instances do you know of this kind ?

Cleon. Not one that I ever heard of.—But there is

is yet another remarkable Peculiarity of this Plant, and that is, that from the Bulbs or Roots at the top of the first Blade, forty Inches high, there grows out two more Blades of fourteen Inches high, on each of which there are five other Bulbs or Roots.—And from these *second Blades*, there grows out another or *third Blade*, with Bulbs upon that also.—So that in this one Instance you have no less than *three Generations* of the Plant, and *four Systems of Roots*, all of one Summer's Produce.—Now let any *Botanist* shew the like of this in any other Plant if he can.—They all produce Flowers, Fruit, or Seed;—but none *Roots*, besides this singular Vegetable.

Euphros. And what have you further to observe of this kind, *Cleonicus*?

Cleon. I think those Instances of *Mimic*, or *imitative Nature*, which we observe in many Vegetables, are the plainest Proofs of imitative Wisdom and perfect Design.—A Person *must* be thought insane that should assert, that a Plant should by *Chance* only, *imitate Animal Forms and Likenesses* in the Fruit, Seed-Vessels, &c. as is observed in many particular Species.

Euphros. I scarce know what you mean *Cleonicus*; pray oblige me with some particular Specimens of these Vegetable Imitations.

Cleon. I will mention a few;—the *Orchis* or *Bee Plant*, is an admirable Instance of this kind; the Flower so nicely represents a BEE, in Body, Head, Wings, Colour, &c. that at a little Distance, and not thinking of it, you would take it for the Insect itself.—I have here brought you a few of the common Sort for your Inspection—look at them.

Euphros. On my Word, *Cleonicus* I never saw a prettier Deception—one would take them, indeed, for so many Bees—how wonderfully natural the Imitation, the Semblance of an Insect!

Cleon. How would you be delighted with a View of some thousands of them together in Pasture Grounds where they grow!—In this *sportive Mimicry* of Nature there is also very great Variety; for some *Orchices* represent *Drones*, some a *Wasp*, others, different Sorts of Flies; and, lastly, some mimic the naked human Body, and are called the *Green-Man Orchis*.—Are not these Productions wonderful

derful Instances of Design, nay even of Pleasantry, in Nature itself!

Euphros. I should think no *Atheist* could dispute it.— But go on *Cleonicus*, to rehearse more of these curious Oddities of Nature's handy Works.—

Cleon. I will, my *Euphrosyne*—but, previous to that, pray Answer me one Question:—*How many Eggs* do you see upon that Plate before you?

Euphros. Why, *six* to be sure—wherefore does *Cleonicus* smile?

Cleon. I smile to think that I have deceived you in the same Manner as you do your unsuspecting Pullet, by taking away her new-laid Egg, and laying a *Chalk one* in its Room—for one of those Eggs on the Plate is the Egg, not of an *Animal*, but of a *Plant*, which is therefore called the EGG-PLANT.—I have here brought you a curious Root of this *Oviparous Plant* in a Pot of Earth for your Garden, my *Euphrosyne*,—and then you will observe the whole Process of Nature in its Production from *Planting* to gathering its Seed—for this Egg which you admire, is only the *Capsule* or *Seed-Vessels*, as you will find by opening it.

Euphros. I shall attend to all the Appearances of so singular a *Phænomenon* in every Stage of its Growth.— I fancy you design to make a *Botanist* of me before you have done, *Cleonicus*.

Cleon. That is my principal View—for though a *POESY* of fine Flowers may curiously ornament the Person of my *Euphrosyne*, yet a little *botanical Philosophy* will as much embellish and enrich the Mind, which is the noblest Improvement Human Nature is capable of.—But having some other important things of this kind to acquaint my *Euphrosyne* withal, I shall postpone them to our next leisure Hour.

D I A L O G U E VII.

The foregoing REFLECTIONS on NATURE'S MIMICRY continued, in EXAMPLES of the SNAIL-PLANT; CATERPILLAR PLANT; URCHIN or HEDGE-HOG PLANT; SEED-POTS with LIDS; concluding with an ACCOUNT of the enormous SIZE and AGE of the BAOBAB, or Calibash-TREE of SENEGAL in AFRICA.

Cleonicus.

WE shall now resume our former Subject, or Speculations of the MIMICRY of NATURE in one Department of her Operations, of what she performs in another.—If she makes *Snails, Caterpillars, Urchins, &c.* in reality in *Animal Forms*, at one time, 'tis pleasant to observe how nicely she gives us their Representations in *Vegetable Forms* at another.

Euphros. You have already obliged me with some striking Instances of that kind, but as such extraordinary Productions can never fail of giving the highest Pleasure to a rational and contemplative Mind, so I beg *Cleonicus* will proceed to entertain me with further Specimens of this Sort.

Cleon. There is a *Genus* of Plants called *Trefoil* for its having *three Leaves* on a Foot Stalk, like *Clover* which you see in the Fields, which is only one, though a principal Species of it.—But there is another called *Medicago*, of three different Sorts, whose Seed-Cases are remarkable for being in an *Animal Form*.—This is one, for Example, which you here see, my *Euphrosyne*.

Euphros. I presume this is the Seed-Case of the *Snail-Plant* you mentioned, because I can see a Semblance of a Snail-Shell in it.—It has various *Spirals* and *Circumvolutions* in it, as most of those Shells have.

Cleon. You rightly judge of it, my *Euphrosyne*.—When this *Vegetable Pod* (or seeming *Shell*) is uncoiled and extended

ended, it is four or five Inches long, and contains several Seeds, at certain Intervals, through its Length.—But to give you a more perfect Idea of this whole Affair, I have brought you a Pot with the Plant in it, and desire you to place it in your Garden on purpose that you may have an Opportunity of observing the whole Process of Nature in these curious Imitations.—I have also brought you a Pot of another Species of the *Medicago*, which you see is a Trefoil, bears a Yellow Flower like the other, and on some of the creeping Stems the Fruit or Seed-Pods of a longish Form, shriveled and irregular, of a Brown Colour, and hanging from the Side of the Pot, look in an indirect View, like so many *Caterpillars* crawling upon it.——

Euphros. Indeed I think they do;—it may well be called the *Caterpillar Plant*, as it resembles some sorts of those Animals so nearly in Size, Colour, Form and Attitude.—But you mentioned another Species of this Plant, which produces the *Hedge-Hog* Seed-Case, pray *Cleonicus*, have you brought me a Pot of them too?

Cleon. I have, my *Euphrosyne*,—here it is—you observe the same Appearance of the Plant nearly as in the other Species, the *three Leaved Foot Stalk*, the *Yellow Flower*, &c.—But the Seed-Case is remarkably different, being as it were *Globular*, and thick set with Spines or Prickles, consequently must resemble a *Hedge-Hog*, when rolled up into its round Form.——

Euphros. But in the *Hedge-Hog* you gave me, the Spines are *strait*, but those in the Seed-Pod are very much *curved*, I see; in other respects, there is undoubtedly a very considerable Resemblance in the Form.

Cleon. 'Tis true my *Euphrosyne*, these Spines or Thorns are curved or hooked, sure enough.—But do you see the Reason of that, or rather the necessity of it?

Euphros. I cannot say I do, *Cleonicus*;—The Surface of the Pod being a little confused with so many Hooks or Spines, I fancy, prevents my forming so clear a Judgment of the Reason of so wonderful a Construction of this Part.

Cleon. Wonderful indeed, you will think it, when you see the Seed-Pod unraveled, and extended to its full Length,

Length.—You will see very plainly, that it is a Globe consisting of several *Wreaths* or *Spirals*, like the Snail-Shell, though in a different Manner put together.—That they begin immediately from the Pedicle or Foot-Stalk, and in seven or eight Wreaths, end in the Top or opposite Part.—That when I unravel it, by disengaging the Wreaths from each other's Hooks, it appears to be somewhat like the common Cases of Pulse, as Pease, Vetches, Lupins, &c.—That on each Side of the Wreath or Case there are firmly fixed strong Spines, curving or bending alternately contrary ways.—That therefore (being made just long enough) they reach over and firmly grasp the Wreath on either Side, almost exactly in form of a Reaper's *Hook* or *Sickle*.—As I unwreath it, and draw it out, you see the small Seeds drop out upon the Table, almost like *Kidney Beans*.

Euphros. I do; and I further observe that the hooked Spines are now more distinctly visible than before.—And with my Explorer I see their very strong Contexture, their sickle-like form, their sharp Points, and their contrary Positions and Directions, much better than I could do in the coiled up State of those Pods.—What an immense deal of Pains (humanely speaking) does Nature take to secure the Seeds of *Medicago*, while, on the contrary, she gives Wings to those of the *Dandelion* to fly away with the least Breath of Air!

Cleon. Such Variety in her Operations can only serve to convince us, that she acts freely, and with the most consummate Wisdom and Design.—That our Reason might always convince us from her Works, *the Hand that formed them was divine*.—For my own Part, I know of no Piece of *Natural Mechanism* more striking than this under Consideration.—The manifest Wisdom and Contrivance therein, so evident upon the very Face of it, affords a much stronger Confutation of *Atheism*, than all *Beniley's Sermons* put together.

Euphros. Why, indeed, if my dear *Cleonicus* should turn *Parson* for once, and preach a Sermon from the *Bible of Nature*, taking his Text from three Verses relating to *Medicago* (in the Chapter of *Vegetables*) he would, I am well assured, find not a single Person yawning or sleeping in his

his whole Congregation.—But this by the way; what further Observations have you of this curious Sort to entertain me withal?

Cleon. Indeed I cannot say, that for Nature to make a *Pot*, and a *Lid* (with a *Rim*) to cover it, is any Imitation of the *Potter's Art*, because Nature was first in Being;—But such *Pots* and *Lids*, to hold and cover the Seed in some Sorts of Plants, particularly in the *Blessed Thistle*, (or *Carduus Benedictus*) a Specimen of which I have here brought to shew you, though no doubt you have seen the Plant and observed the Flower, as being very common, and very beautiful.—But now my *Euphrosyne* must regard and reconnoitre it with a Philosophic Eye ———

Euphros. That I shall be ready and glad to do.—Pray shew me those *Pots* and *Pot-Lids*, you speak of, *Cleonicus*; I pre-suppose they are contained in those numerous Cases on the Sprig you hold in your hand, are they not?

Cleon. They are so, my *Euphrosyne*,—and the *Pots* not only hold the Seed, and have *Lids* to cover them close, but Nature has contrived to keep the *Lid* upon the *Pot* by the peculiar Form of the Cases or Empalement which includes them, and which you see is contracted in the middle Part, just over the *Lid*, to prevent its rising up by any accident before the Seed be ripe—I pull the Case open, and is there not a beautiful appearance of a *Pot* and its *Lid*?

Euphros. Sure enough there is—I observe the *Lid* has a *Rim* round it, so that it can only cover, but not sink into the *Pot*.—The form both of the *Pot* and its *Lid* is very Neat and Elegant—Could I have a *Tea Pot* and *Lid* fashioned from such a divine Model, I should prize it far above any I ever saw from *Nanking*.

Cleon. Since you are so much delighted with this kind of Pottery in *Vegetables*, I must present my *Euphrosyne* with a Specimen of this *Figuline Art* also in the *Animal Department*, where Nature has proceeded a step farther, and connected the *Lid* to the *Pot* by a strong Ligament or Cord.—What do you see here in this Concave, my *Euphrosyne*?

Euphros. See—why nothing but what I have seen an hundred times over before—white things in a Cluster,
that

that I have often seen sticking to Boards, Walls, Sides and Corners of unfrequented Places, &c. but I always thought them the Eggs of Insects, and not worth Notice—

Cleon. You will now be convinced of your Mistake—and that there are no Parts of the Works of Nature but what are well worth your Notice.—I place the *White Things* as you call them, under the Glass—where view them, and tell me what you think of them now—

Euphros. I see them—I am amazed at the Difference of the View—why they seem now to be all of them long, hollow, Silken Bags, open at one End—round and close at the other.—some are so at both Ends—Where the End is open I observe the Edge is curiously wrought—I further notice the hollow *Lid* or *Cover* you spoke of, which seems nicely fitted to the Aperture of the Bag or Case—and, lastly, in some of them I can distinctly discern the *Silk Cord* which fastens it to the Case.—Pray what can all this mean, *Cleonicus*?

Cleon. You might just as well ask, *what the whole Creation means?* the answer would be—*To shew the Glory of God in an infinite Variety of his handy Works.*—But, in short, my *Euphrosyne*, the History of the present Phenomenon is this—Nature has furnished different Sorts of Flies with sharp Pointrels or Spears in their (*Podex* or) Tails, which they have a power to dart out, and thereby to pierce and make small holes in the Bodies and Leaves of Plants, and some in Animals also, in order that they may therein deposite their Eggs—Among these latter is a certain Fly which lays her Eggs in the warm Body of the Caterpillar, where they are soon hatched, and produce several (*Erucae*) Vermicules or small Maggots.—These are fostered in the Reptile's Bowels till they attain their mature State—then they eat their way out, which proves the Death of the Caterpillar soon after.—These Vermicules have no sooner released themselves from the Reptile, than they fall to Work in Weaving a fine *Silken Case* or *Coffin* wherein to lay themselves up for their destined *Transmutation into Flies.*—These are curious Cases or Silk Bags which you see, taken directly from the Body of a Caterpillar as soon as they were finished;

—But in these you observe no Cover by your best Glass—both Ends are alike round—When it has lain in this inactive torpid State the appointed Time, the Fly is produced, and gradually getting Strength, bursts open the Prison Door, or throws off the Cover, and flies away at large.

Euphros. Wonderfully strange and mysterious is this whole affair! when I view the open Cases (cut lengthways through the middle) by the Microscope, they appear like a Sort of Natural *Filligree Work*, inimitable by any *Silver-Smith* or *Silk-Weaver* in the World—

Cleon. They do so, and shine like burnished Plate, by Reason of the exceeding Whiteness of their Silky Web, and the transparent Colourless Glue by which the Contexture is made hard, pellucid and very elastic; and polished to an admirable degree by the smooth Surface of their Bodies. —But it will soon be time to conclude, this our last Speculation on *common Vegetation*, which I think I cannot better do than by a short Recital of some of those amazing Instances of extraordinary Vegetation we meet with respecting the Enormous Bulk, Foliage and Age of some Trees.

Euphros. I remember you gave me an astonishing Account of the Bulk or Size of a Chestnut Tree (part of whose Trunk is still to be seen) that once grew and flourished on the Side of *Mount Ætna*.—Pray, *Cleonicus*, do you think of any thing that exceeds such an unheard-of Bulk?

Cleon. Not in regard to Bulk in particular; but take the whole together of *Size, Foliage, Age, &c.* I believe there are Trees now growing, and in a flourishing State, in the Country of *Senegal* in *Africa*, which must be allowed Nature's greatest Atchievement in Vegetation ever known in the World.

Euphros. And pray what wonderful Trees are these, *Cleonicus*?

Cleon. They are called in that Country *BACBABS* by the Natives; but by the French, the *CALIBASH-TREE*. —There is an Account of this Tree in the *Memoirs* of the *French ACADEMY* for the Year 1761, by Mr. *Adanson*, who residing there, saw many of them of different Sizes; but few of them exceeding twelve or fifteen Feet in height

height of Stem, or from the Root to the Branches, and in girt Seventy-five to Seventy-eight Feet; which give from Twenty-five to Twenty-seven Feet Diameter.

Euphros. This is undoubtedly a most extraordinary Size; but still that of the *Horse Chesnut* on Mount *Ætna*, does far exceed it, as being more than twice as much in Diameter.—But what I think very odd, is, that the Huge Trunk of this *Baobab* should have a thickness more than double its Height according to this Memoir.

Cleon. It is in this Respect a Singular and strange Phænomenon, but much more so yet in another, which is its Wonderful *Branchery* and *Foliage*.—The Limbs of this Tree, which are longest and lowest, spread all around to the Distance of Sixty or Seventy Feet, and are so large and heavy that they bend down to the Ground, and hide the Body of this monstrous Tree—other Limbs above rise higher and higher, quite to the Perpendicular—these also bending by their Weight, make altogether the Appearance of an Hemispherical Head or Mass of Green Foliage one hundred and twenty, one hundred and thirty, or one hundred and forty Feet Diameter—with a *Concave* underneath as large, making a Habitation for *Monkeys*, who live in this Tree in great Numbers, principally upon the large Fruit it produces, which the French call *Pain de Singe*, or *Monkey's Bread*.

Euphros. What wonderful Things there are in the World! one can scarce form an Idea of such extreme degrees of Vegetation.—Pray, *Cleonicus*, are the Leaves, Flowers, Fruit, &c. proportionably large?

Cleon. The Leaves and Flowers are not, the former being but about five Inches long, and the latter six Inches wide—but the Fruit is very long and large.—The Bark of the Tree three fourths of an Inch thick—and the Wood White and Soft.

Euphros. Did the Gentleman say any thing about the Age of such marvelous Productions, *Cleonicus*?

Cleon. Only this—that some names are still to be seen which were cut in the Bark in the Year 1555, from whence and from other Circumstances, he conjectured, it was probable they began to exist not long after the Flood.

--If we allow the Chestnut Tree on *Ætna* to have increased in Diameter $\frac{1}{10}$ of an Inch, one Year with another, it will appear to be eight thousand Years old, much older than the World itself, according to the vulgar Account.

Euphros. But that Supposition will prove too much, *Cleonicus*—

Cleon. I can assure my *Euphrosyne*, that his *Sicilian Majesty's Topographer* has by Experiments proved much more.—By digging through the *Lava* in the level Country adjoining to the Foot of the *Volcano*, he observed the gradual Increase of the *Strata* or *Layers*, from time to time, and plainly proves from thence that the Age of *Mount Ætna* is many times greater than that of the World.—But it grieves the Good Man, that he dares not divulge what he proves to be fact—and it is time to desist, my *Euphrosyne*, when we are in reality arrived to a *Ne plus ultra*.

DIALOGUE VIII.

Of Marine VEGETATION. Of Submarine PLANTS
in general. Of Arboreſcent Submarine SHRUBS.
Of various Forms of CORALLINES. Of Coral
TREES. Of MADREPORES, ASTROITES, &c.

Cleonicus.

WE are now, my *Euphrosyne*, launching into the boundless Ocean, to explore the Wonders of the Great Deep, particularly those which are of a *Vegetable Nature*, and appear in the form of *Plants*, *Shrubs*, and *Trees*.—For Vegetation and Vegetating Bodies are not more common and visible on the Land, than in and on the Sea Coast, under the Water, every where.—But the Subjects and Substances of *Marine Vegetation* are very different from those on the Land.—The manner or mode

mode of Vegetation itself varies also very much from that in Land Plants.

Euphros. Pray in what Particulars does the Marine Vegetation differ from that in our common Vegetables?

Cleon. Vegetation in the Earth is carried on by a Circulation of Fluids through the Organical Parts of common Plants, but in those of the Sea nothing of that kind appears.—All Land Plants germinate from a Seed; but the Origin or Generation of a Sea-Plant is not yet known, as no Flowers or Seeds in them have been yet discovered with any certainty.—A Land-Plant draws its Nourishment from the Earth by means of a Root, and its numberless Ramifications and Fibres; but nothing of this kind, is seen in a Sea-Plant.—They are fixed by a broad Basis to the hard Surfaces of Stones, Rocks, &c.—they seem to receive their Nourishment, and Principle of Growth through the Surface of their whole Bodies, and not from one Part only—in short the most of what we know of Sea-Plants is what the MICROSCOPE discovers of their form, Fabrics, and component Parts.

Euphros. They seem indeed to be every way of a different Nature and Construction, not only from our Land, but equally so, from our Water Plants.—I suppose it in vain, *Cleonicus*, to enquire about your *Method of Glassing* these *Marine Plants*—for I see such multitudes of them which you have here brought together in my View, and as far as I can perceive, no two alike, that I don't expect that you can make a very minute Distribution of them into particular Classes or Orders, if you were ever so willing,

Cleon. Indeed you say right, my *Euphrosyne*; it would be to little purpose to make more than three general Distinctions into PLANTS; *Arborescent SHRUBS*, or *CORALLINES*; and *CORAL TREES*—for the hard Substance of which these submarine Trees consist, is usually called *CORAL*—but what the substance of *Coral* is, we know no more than what the substance of *Wood* is, or that of any other Body.—The *Qualities* of Bodies are all we are permitted to know—and we find that a *Tree of Coral* is as much a *Vegetable* as a *Tree of Timber*, though the Mode thereof,

thereof, and the Way of Nutrition, be quite different in the Mediums of *Earth*, and *Water* of the *Saline Kind*.

Euphros. I observe, from a general View of those you call Submarine Plants, that there is an infinite Variety in their Forms and Mode of vegetation.

Cleon. There is my *Euphrosyne*—for some of them grow into long, broad, single Leaves—others branching out into many broad thin Leaves, without any Foot-Stalk—some grow from Pedicles, and branch out into little Twigs, with thin white spreading Leaves on the top, almost transparent—some rise from a small Stem, and then become ramified into a Sort of narrow, flat, thin Leaves or rather Branches, and these again subdivided into various others, till they make a large spreading Head.—A great number rise in form of a Stem, Limbs, and Leaves, like those of a Fern Branch; of which some are smooth, others hairy, &c.—Many different Species consist in slender transparent Stems, and numerous Branches, with Twigs, all knotted or jointed, and at every Joint are two thick short pointed Parts growing out—others shoot out into one continued tall Spire, jointed all the way up; and knotted and hairy at each Joint, and every where transparent—while many others are quite opake, white, jointed, smooth, low, and like a Bush, for a number of Parts grow from one Root—many are of a spongy Contexture, yet branching into a sort of thick Leaves or *bald* Limbs.—The *Spunges* we have in common Use, make another Order of Submarine Vegetables—with numberless others, too many to be detailed at this time.—I shall give you Specimens of most that are of Note, put between the Leaves of a Book, which you may look over at your Leisure, for the best sort of Information you can get of these Subjects, will be by the *Parlour* and *Solar MICROSCOPES*.

Euphros. I am much obliged to *Cleonicus*, for so great a Variety of beautiful Sea Plants—How wondrous their Forms! how beautiful their Colours, when displayed! what a number of *Microscopic Objects* will they afford me at times for my Amusement!—but pray, *Cleonicus*, how does such wide spreading Heads of Plants support themselves in the Water upon such very slender Stems as most of them have?

Cleon.

Cleon. They are considerably lighter than Sea-Water, and are therefore supported by it.—When, by accident, they are torn from the Rock, Stone, or Shell, they swim; and are washed to Shore by the Surges of the Sea, in great Quantities, on many Parts of our Coasts.—Here the *Vertuosi* find a Treasure.—The Farmer carries away Cart-Loads to manure his Land—and those employed by the *Glass Manufactory*, burn the Sea-Weeds for the Salts which their Ashes contain.

Euphros. So it appears that even Sea-Weeds are of very great Use to Mankind.—But pray *Cleonicus*, what is that white Substance which I see in Patches about upon the Surfaces of the Leaves, and sometimes so large as to cover them entirely for a great Way together.

Cleon. They are very fine Bladders which grow from the Surface of the Leaf, on each side as thick as they can stand by each other, in an *oblique* or leaning Position—at first they appear with round Ends entire—afterwards an Aperture at the End of each begins to appear, and grows larger and larger—at length this Aperture becomes as large as the Bladder itself, and then the Form of the Bladder is changed into that of a cylindric Cell or Cup, whose Orifice is set round with eight or ten small white Spikes, curving inwards—the Surface of these Cells you see perforated with small round holes which make a very pretty Appearance in the Microscope, where I have placed these Cells for your View—look at them my *Euphrosyne*—

Euphros. I do, and a curious spectacle they make—I see every individual thing you mention—Pray what can be their Use to the Plant, *Cleonicus*?

Cleon. No doubt but they are necessary to its Vegetation, but in what manner is not for me to say.—It is very remarkable that Fire alters not their Form in the least.—This piece has been made red hot in the Flame of a Candle—now take a View of it—

Euphros. I see not the least Alteration in the Form of the Cells—their Surfaces, Perforations, Spikes, and every Part the same as before—only now they appear *Milk-white* and more perfect, if possible, than before.

Cleon. But the whole falls to Ashes upon the Touch—which contain more Salt than the Ashes of the Land-Plants

Plants by much.—*Ten* grains of a *Sea-Plant* lost in the Fire *six* grains; but ten grains of a *Land-Plant* will loose more than *nine* by the same Calcination—consequently the former is much more fixed and compact, than the latter.

Euphros. Well I have heard you with pleasure on the *Plants, Cleonicus*;—what am I to understand by your second CLASS of *Arborescent SHRUBS, or CORALLINES*?

Cleon. The Submarine *Arborescent Shrubs* are such as you see here in various Specimens, chosen on purpose for your inspection—these, properly speaking, are not *Corallines*, as there is nothing of the Nature of Coral seen about them—so far from it, that some of these Shrubs seem rather to have some Parts resemble the Texture of *Bark and Woody Filaments*, though not really such—These Sea Shrubs have very short Stems, branching out, and subdividing into many upright Sprigs, of a considerable height—these have no lateral Twigs, Leaves, Flowers, or Fruit—the substance is very simple, consisting of an upright Stem and Branches, covered on the outside with a thick crustaceous Coat, and containing within a hard Substance of a dark colour, and brittle as Barley-Sugar—all this is evident to your View in the several Shrubs before you, in Pieces that are broken off for that purpose.

Euphros. I see a great variety in the coating of the different Shrubs; but very little in the Stems themselves.—I observe in some, it is very thin, in others very thick—in some it is smooth, in others very rough—in most Sorts it is of a roundish Form, but in some, I see it consists of three Sides.—It differs greatly in colour too; a fine *Purple*, a *Yellow*, an *Orange*, a *Pink*, a *White*, severally adorn them.—*This Coating* is of so brittle and crusty a Nature, that I can rub it all to a Powder in my Hand.—With my Explorator I see it is full of small *Holes* all over the Surface—some of these are round; others long; some of a Conical Figure—In others I see no Hole, or any thing like one—

Cleon. Your Remarks are very just in every respect, my *Euphrosyne*.—Under this crustaceous Bark is contained a Sort of black *Sea-Wood*, which makes the Body
of

of the Shrub—it is almost like *black Ebony*—but in small Twigs, it appears of a *Yellowish* colour—it seems very close and compact, without any Pores—it is hard to cut with a knife—it breaks with difficulty—and burns in the Flame of a Candle to a black Coal—being taken out of the Flame, it is glowing for some time—when thoroughly burnt, it falls into a *white Ash*, like common Wood-Coal—During this Calcination, it omits a great deal of black Oil, which runs down upon the Pincers that hold it——

Euphros. These are sufficient Proofs of its being Wood, though of a very peculiar Sort.—Here seems to be something of a like Substance in this odd Production, pray what do you call it *Cleonicus*?

Cleon. It is called, the SEA FAN——It grows from a Basis upon the Rock, like the other Shrubs, but its Ramification is its Branches, all connected with each other, spreading wider upwards as it grows higher, till it almost acquires the Form of my *Euphrosyne's Fan*.——It is certainly a very great Oddity—but our next Subject is still more singular.

Euphros. Pray what may that be *Cleonicus*?

Cleon. This beautiful Species of *true CORALLINE*, which you observe has a most delicate Appearance of *Wood and Coral* joined together throughout the whole Body of the Plant.—The Woody Part is of the same dark Yellow as that of the Shrubs, and appears to be of the same Texture when applied to the Flame for *Calcination*.—The *Coralline* Part is white, and consists of a Sparry Crystal Substance, or hard flakey shining Matter, as you may see when broke asunder.—But the Surface is every where neatly fluted or channeled all around.—And this Coralline Part is curiously set or joined in the Sockets of Wood on each Side.—A Plant composed of two such different Substances, placed alternately one in the other, through the whole Fabric, is no where else to be found among all the wondrous Works of Nature that I know of.—There is a larger Species of this same *Coralline*, covered all over with the same *thick crustaceous Coat*, as you saw on some of the Shrubs, as will appear by taking it off from any Part or Branch.

Euphros.

Euphros. I see every thing with Admiration that you describe.—But pray tell me next, *Cleonicus* how these *Coralines* differ from *Coral* itself?

Cleon. CORAL consists altogether of a Vegetable *Spar* or *Crystal*, which the Earth produces, and is nourished by the Sea-Water.—It chiefly grows upon Rocks, and is of various Species, Forms, Sizes, and Colours.—The most perfect Sort of Coral is the Red and the White, for the Black Coral is no Coral at all, but a *Submarine Wood*.—The Trees of *Red and White Coral* are covered with a soft crustaceous Coat, which easily comes off when they gather it, and then it appears of a smooth polished Surface as we usually see it.—Besides the true Coral, there is a less perfect Sort, not near so solid, compact and sparry, but full of Pores on the outside, and of Vacuities within.—This Species is called *Madrepore*, and grows to the Height of two or three Feet, and spreads into a Head as wide,—a compleat Tree of this kind I have procured for my *Euphrosyne's* Examination at leisure Hours.

Euphros. Well, this is a noble Present indeed.—I never saw a Coral Tree before—I cannot but admire its wonderful and strange Form and Manner of Branching out into such a Number of Parts, every where alike.—I see the Surface very rugged, and full of Pores all over.—I should be glad to see how it appears within when broken, *Cleonicus*?

Cleon That you will do, my *Euphrosyne*, in a Piece I just now broke off for that very Purpose.—You see the large Pores on the outside penetrate into the Body of the *Madrepore*, every where.—That the Substance is not solid, but full of Vacuous Spaces, like Bladders, in all the middle Part—some in a perpendicular, some in a lateral Position.—You further observe the Substance is very friable, and is easily reducible to Powder.—But the greatest Curiosity of this kind that I shall be ever able to shew you, is a Specimen of *Madrepore* from the Rocks of *Canada* in *North America*, which when broken, exhibits a lovely *Blue Colour* to the Eye.—A Spectacle (or Species of Coral) not found on this Side the *Atlantic* that I have ever heard of.—It is also of that Sort

Sort called *Astroites*, because the *Orifices* of the large *Pores* seem, at a *Distance*, like so many *Stars*, and variegated with *Black and White Rays*.

Ephros. These valuable *Specimens* of *Coral*, particularly the *American Blue*, will greatly enrich my *Collection*, and engage my *Esteem* and *Affection* for the kind *Donor*.

PHILOSOPHY.

PART V.

CONTAINING

A GENERAL SURVEY OF THE CONSTITUTION OF THE EARTH, ITS SURFACE, AND MINERALS, TOGETHER WITH THE HISTORY OF THE METALS.

DIALOGUE I.

THE FOUNTAIN THEORY OF THE FORMATION OF THE EARTH, AND VEGETATION, AND THE HISTORY OF THE METALS.

THE FOUNTAIN THEORY OF THE FORMATION OF THE EARTH, AND VEGETATION, AND THE HISTORY OF THE METALS. **THE** FOUNTAIN THEORY OF THE FORMATION OF THE EARTH, AND VEGETATION, AND THE HISTORY OF THE METALS.

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART V.

CONTAINING

*A General SURVEY of the CONSTITUENT PARTS
of the EARTH near its SURFACE, viz. MOULDS,
STONES, FOSSILS, MARCASITIES, ORES, and
METALS.*

DIALOGUE I.

*The genuine THEORY of the FORMATION, PRO-
DUCTION, and VEGETATION of Terrestrial
BODIES in general.*

Cleonicus.

WE are now, my *Euphrosyne*, arrived to the last
great Department of Nature's LABORATORY,
wherein most of her wonderful Works have their Origin,
which we view above the Surface of the Earth; and
numberless others begun, carried on, and compleated
quite out of our Sight beneath it; of these we should
know nothing at all, were we not to dig for such *hidden
Treasures of Knowledge*.—As to the *Form and Constituent
Parts*

Parts of the Earth, there is no doubt but it was always the same from the Beginning as it is now, and will be as long as it exists.—And as to the Method of philosophizing about the Phænomena of its Operation and Produce in its Interior Parts, we must shew by Experiments that it depends upon *three Fundamental Principles*.

Euphros. And pray what are these *Cleonicus*?

Cleon. The *first* is an Universal Power, Energy, or Spirit, which is the *Divine Agent*, or *Efficient Principle* by which the whole Mass of Matter in the Earth is actuated, agitated, and put into constant Motion.—The *Second Principle* is, an Universal Power of *Vegetation* by which all Bodies in the Earth increase in Bulk, and grow from small to great,—The *third Principle* is, an Universal *Plastic Power*, whereby every Body in Nature receives its *peculiar and specific Form*, and such a *particular Texture and Consistence*, by which it differs from every other Body.

Euphros. These Definitions and Principles are rather too high for me, *Cleonicus*, till you have accommodated them more to my Understanding, by a proper Exposition and Illustration of each,

Cleon. That is to be the Employment of the present Hour, my *Euphrosyne*.—Therefore with regard to the *First Principle* or Universal AGENCY, it is manifested by every thing we see—We find a genial Warmth in the Earth, and all its Parts, Solid or Fluid—There can be no Warmth in any thing, where there is no Motion of its Parts, for it is that Motion that excites the Sensation of Warmth or Heat, as is known by a thousand Experiments every Day.—Now Matter is of itself absolutely *inert*, or *unactive*, and cannot put itself into Motion—therefore *Motion* must be communicated from some external Agent—but we find Warmth and Heat in all Parts of the Earth, more or less; this proves all Parts are more or less in Motion, and consequently that there is an universal *Agent*, or *Spirit*, or *Divine Power*, which (as VIRGIL expresses it) cherishes, and actuates every Part, and mixes itself with the whole Mass.—He justly calls it, a *Vigour* proceeding from *Heat or Fire*—and it is well known that the Earth is composed of such Parts as are always actuating

each other, and producing great Degrees of *Warmth* and *Heat*; and sometimes of *FIRE* and *FLAME* itself——Hence those wonderful Phænomena of *HOT SPRINGS* every where; and of *terrible VOLCANOS* in all Parts of the Earth——We observe a constant *Perspiration* in the Earth, as well as in Animals, and Vegetables.—This Perspirable Matter is indeed invisible in the Summer Heat, but is condensed into Fogs, Mists, &c. by the Winter Cold, as we see by our own Breath—The various Materials of which the Earth is composed, naturally ferment, more or less, as Filings of Steel and Sulphur made into a Paste, will ferment, grow Warm by degrees, then becomes *very Hot*; and at last *kindles into a Flame*.—We see, not only warm and cherishing Vapours constantly exhaling from the Earth, but in some Parts very hot Ones; and in others it breaths Smoke and even *Fire* itself, as in the Vale of *Salfatara* in *Italy*. There are many other Phænomena which prove a constant Motion of the Earth from the *Central Parts towards the Surface*.—Witness the constant Supply of fuliginous and inflammable Matter to Volcanos through all Ages of the World.—Of *Islands* rising out of the Seas, where none had been seen before.—The constant *rising of Stones* from the internal Parts of the Earth to the Surface, though gathered from thence every Year.—The constant Appearance of *fractured Stones*, and *Flints*, in Gravel and Chalk Pits, which must be the Effect of the internal Heat.—These Stones and the Pieces belonging to them are never found together in the Beds or Layers where they were formed and broken; which plainly shews a Power that urges and carries them in Directions from each other.—These, and many other Arguments that might be adduced, infallibly prove a constant Internal Agency throughout the whole Mass or Body of the Earth.

Euphras. Indeed, *Cleonicus*, I am thereby sufficiently convinced of the Truth of this great Principle you proposed to establish.—Pray by what Observations is your second Principle of an *Universal Vegetation in the Earth*, supported?

Cleon. By the plainest Matters of Fact my *Euphrasynth*.
—We see all kinds of *Spar* grow and encrease in Bulk by
the

the peculiar Juices and Fluids of the Rocks, where they are produced.—We see the various and beautiful *Efflorescences* issue from the Surfaces of hard Stones and Rocks.—A great Variety of *White pure Crystals* in pyramidical Forms, growing extremely numerous and beautiful from many Sorts of Rocky Substances.—Particularly that most wonderful Species called *Island Crystal*, just shooting from the Rock to Pyramids of an enormous Size.—Also small and large *Columnar Crystals*, in large Bundles, rising together from the Rock.—Even *Metals* themselves will assume the Form of Crystals, and grow in large Heads from the *Mineral Stone* or *Ore*, witness those of *Copper*, glowing with their native glorious *Azure* in the *Mines of Cornwall*, &c.—In some Pieces of *Island Crystal* we see a pleasant Spectacle, whole Crops of *Mundic* rising in slender Stems, with their Black Heads filled with *Yellow shining Bronze*, as plainly as the Corn in the Fields.—We see all kinds of *Talks*, and even that wondrous one called *Muscovy-Glass*, grow naturally from hard Earth, and Stony Substances.—That singular *Fossil*, called *Asbestos*, most evidently grows from an earthy Root.—Those Productions we call *Brain-Stones* have all their *Radical Parts* by which they grow from Submarine Rocks.—What the Naturalists call *Pyrites*, or *Fire Stones*, shew the Root from which they shoot upwards in such curious Forms and *Configurations*.—Even common *Pebbles* too, many of which exhibit the most evident Sign of a *Root*, or *Radical Part*, from whence the Substance of the Stone gradually proceeded.—Yea *Metals* in their purest Forms, actually present us with *arborecent Vegetations*, thus we find real Sprigs and Branchery of massy and malleable Copper in *Cornwall*.—All kinds of Metals grow in their proper Earths or Ores; and in particular, *SILVER* discovers as perfect a Vegetation in Branches and Leaves as *Fern* itself can do.—*Gold* grows in Grains in different Degrees of Size.—And *TIN* is frequently found growing in the Form of Pebbles, small and large.—As *Iron* is in very large Stones of the Pebble kind, in *Colebrooke Dale*, &c.—The *Copperas Stone*, plainly grows from a Root.—Also that called the *Starry Waxen Vein*, which when broke, exhibits a most curious Irradiation in the Form of a

Star.—Numberless other Instances might be produced if it were necessary to prove the Existence of this *Universal Power of Vegetation* in and through all Parts of the Earth, and the various Bodies it contains.

Euphof. I think no *Sceptic* can desire more or plainer Demonstrations thereof than you have given.—And now *Cleonicus*, in the last place, please to tell me from what Sort of Arguments you deduce your third *Great PRINCIPLE* of an *Universal PLASTIC POWER* in Nature?

Cleon. By a *Plastic Power*, I understand that which in the Beginning gave Birth to that beautiful Order and Frame of the Mundane System we every where behold.—To that Regularity, Distribution, and Distinction that we observe to be permanent, and at all times uniformly the same amongst all the Myriads of different *KINDS* and *SPECIES* of Beings and Bodies we find therein.—This Power impresses on Matter those general Marks and characteristic *Forms, Shapes, Traits* and *Lineaments*, by which Bodies are distinguished into their *Primary KINDS* and *CLASSES*, and which ever continue the same.—Thus Earth, Sand, Gravel, Clay, Loam, &c. are in all Parts of the World of the same *unchangeable Form and Nature*.—Stones, Flints, *Pebbles*, Slate, Marble, Marcasities, and Metals are constantly the same in every Part of the Globe.—Spars, Crystals, and Precious Stones, are invariably the same for ever.—Skins, Shells, Feathers, &c. are always the same for the same Animals.—The Matter may be what you please, but while it has the same Form, it will constitute the *same Kind of Body*.—If the Form of a *Scollop Shell* be impressed upon the Substance of hard Stone, it will make a *Scollop Stone*, though not a *Scollop Shell*.—And many such Forms of Shells we find every where existing in mere Earth, Sand, Loam, *Pebbles*, the hardest Rocks, and on the highest Mountains.—But the perfect Impression of a *Cockle Shell* in the middle of a small *Pebble*, scarce half an Inch wide, and of the very same Matter with the *Pebble*, is an infallible Proof that it was purely and alone the Effect of this *Plastic Power*, for it would be too ridiculous to suppose any Shell from the Sea could have got into this Infant *Pebble*

Pebble in *Greenwich Park*.—That this Power forms Shells at Land the same as those in the Sea when it has the same Materials to work upon, is evident from what is seen every Year at *Richborough Castle* in Kent, where numberless *small Shells* are constantly formed from the *Spray of the Sea* (at a Mile Distance) and though they are destroyed every Year by the *Ploughing* of the Ground, they are yet as constantly regenerated.—Yea, in many Parts of the Earth, *Shells* are formed in Beds without the least Admixture of Earth between them, as in the *Peasly Grey*, near the *Iron Mines* at *Battle* in *Suffex*.—Again, some hard Stones consist of nothing but Shells throughout.—I have seen Lumps of soft moist Sand, in a Sand-Pit, appear with the Lineaments of *Cockle Shells*, more or less visible, while by the Touch only they would crumble to Powder.—Not only the Impressions of *Shells*, but of *Plants* and *Animals* of many Sorts are found in all Parts of the Earth; the Figure of the *Fern* and the *Fish* may as well be stamped in *Stone*, as in the Substance of a *Plant* or *Animal*.—We find Nature, as it were, sportive with this Power, sometimes in presenting us with the Figures of many Sorts of *Shells*, *Animals*, &c. which were never seen, or known to exist in any Part of the World.—The most remarkable Instance of this kind is the *Serpent Stone* coiled up in folds like a Serpent or Snake, from the smallest Size to the enormous one of two Feet in Diameter, in soft Earth, and in the hardest Stone.—If these are not sufficient Proofs to convince my *Euphrosyne* of the real Existence of such a *Plastic Power* in Nature, I shall relax a little in my Expectation of seeing in my Sister the most accomplished *Female Philosopher*.

Euphros. Oh, *Cleonicus*! You have quite stopped my Mouth.—I cannot say, I am not convinced, for that would argue *Dubness*; nor do I dare to say I am, for that would be passing too great a Compliment upon myself.—However this you may be assured of, that you have thoroughly proselyted me to your *Philosophical Sentiments* so far as I understand them.

DIALOGUE II.

*Of the most remarkable EARTHS; CHALK and FLINT.
Fuller's EARTH; EARTH of the SOAPY ROCKS
in Cornwall. Of Muscovy GLASS or TALK.
Of AMBER, and its Native PROPERTY of AT-
TRACTION. Of the TOURMALIN. Of Medi-
cal ELECTRICITY, and its great USEFULNESS
in curing DISEASES.*

Cleonicus.

IN our last Conference, I took an Opportunity of expounding to my *Euphrosyne* those Principles which relate to such a Theory of the Generation and Production of Natural Bodies, found in and upon the Earth, as I judged most rational and consentaneous to their various *Phænomena*.—I shall now proceed to a brief SURVEY of such *Fossil* and *Mineral* Subjects as are most rare and extraordinary, and which attract our Attention and Admiration on Account of some signal and singular Properties and Qualities we find them possessed of.

Euphros. Such Topics must afford Matter of curious and instructive Speculation; and as you propose to illustrate each Subject by *real Samples* and *Experiments*, so I cannot doubt of being able to comprehend the greatest Part of what you may deliver on these intricate and less known Parts of *Natural Science*.

Cleon. I shall pass by the well known Subjects of *Earths*, *Sand*, *Gravel*, *Clays*, *Marls*, &c. to those that have been less observed and esteemed valuable Curiosities on one Account or other.—Among these I shall not hesitate to give CHALK a Place—I don't know another Instance where Nature has so much contrasted the Parent to its Offspring.—The softest and whitest Substance here produces the hardest and blackest of Bodies, the FLINT.—A Body of the utmost Use in striking Fire with Steel.—Chalk is converted by Art into *Lime*, *Whiting*, &c. so
very

very necessary in Building, and many Domestic Uses, as my *Euphrosyne* very well knows in regard to her Silver Trinkets.—*Chalk* is the most remarkable Absorbent in Nature, and worth all the *Foreign Earths* imported from abroad, being a Specific for the Heart-Burn infallibly.—Again, *Chalk Hills* afford us the best SPRINGS of *Soft WATER*; and soften *Hard Water* the best of any thing.—Lastly, *Chalk* is an excellent *Manure for Land*.

Euphros. These useful Properties certainly render Chalk a Celebrated Fossil.—Pray, *Cleonicus*, What do you say of FULLER'S EARTH, of which we make such constant Use in taking out *Spots of Grease, Oil, &c*?

Cleon. I can say nothing more of it than what you have said yourself my *Euphrosyne*.—Its peculiar Property of *scouring and cleansing CLOTHS and STUFFS* from Oil, Grease, &c. made Use of in manufacturing them, has rendered it an *Essential Article* in the *Fulling Trade*, and therefore of the utmost Consequence in Commerce; and, of course, entitles it to a distinguished Rank among *Fossils*.—Indeed the Microscope shews nothing in the Particles of this Earth different from those in any other; so that the Cause of this Effect is yet a *Secret*.

Euphros. As Nature has been so kind to indulge me with so useful a Material, I shall excuse her for keeping its Operation a Secret —What is your next Fossil of Note, *Cleonicus*?

Cleon. Something that you would imagine by all your Senses was much more likely to *full Cloth* than the Earth now mentioned.—It is the *Earth* from the SOAPY ROCKS in *Cornwall*, near the *Lizard's Point*.—There are two of these Rocks, at five Miles Distance.—The singular Property of this Earth is, that it has all the Appearance of a *Natural SOAP*, both to the *Eye* and to the Touch, in respect to *Smoothness, Lubricity or Slipperiness*, at the same time that it has none of the Effects of *Soap* or *Fuller's Earth*.—In one Rock the Earth is much whiter and softer than that of the other.—There are several Pieces from each Rock, which I procured for your Inspection—look at them, and take them in your Hand.—

Euphros. Upon my Word, *Cleonicus*, if my Eyes were shut, I should imagine I had so many Pieces of hard Soap

in my Hands.——Why they have not only a soapy Touch, but they actually look like Soap.——The very Pebbles seem slippery, as if rubbed with Soap, and they have a soapy look.——What I wonder at, is, that it does not stick to my Hands and Fingers—instead of that, it leaves them quite clean and dry.——Well, I never saw a greater Deception.——It will not, by what you say, either lather like Soap, or take out Spots of Grease like Fuller's Earth.——Pray to what Uses may it be applied, *Cleonicus*?

Cleon. It is monopolized by the *Manufacturers* of *English CHINA*, on account of its whiteness, fineness, and firmness of its Grain.——But after all, we have nothing to compare with your *Nankeen* and *Dresden*.

Euphros. I believe so, *Cleonicus*; for though I admire this *Mimic Earth* as an excellent *Natural Curiosity*, yet I do not admire the *China* that is made with it at all.——Now what remarkable Fossil have you for our Contemplation next, *Cleonicus*?

Cleon. Why that is a Piece of Nature's *GLASS-MANUFACTORY*, what we commonly call *Muscovy GLASS*; and is the principal and most noble Species of *TALK*, that the Earth produces.——It is dug out of the Mountains in the northern Parts of *Muscovy*, from a hard Earth to which it adheres, as seen in the large Lumps that are brought from thence to us.——All the internal *Talky Part* consists of an infinite Number of *Laminæ*, Plates or Flakes of a tough, transparent, polite Substance, very much resembling thin Plates or Sheets of Glass.——It is easily split, sliſtered, and separated into Plates and Pieces, more or less transparent, as they are thinner or thicker.——They are often so very thin as to float in Air—and to produce the most intense and brilliant *Colours of Light* by Reflexion, that can be seen in Nature.——They have nothing brittle in their Composition—but very elastic and strong, (though extremely thin,) and pliant to the last degree.——Hence their great Utility in Optics, as the most proper Means for holding Objects placed between two of them, to be viewed in the Holes of Sliders under the Microscope—as they may be taken of any Thickness, Length, or Breadth that *Lanthorns* may require, so they are much more

more convenient to put into those Utensils than *Glass*, which is *brittle*; or *Horn*, less pellucid.—Besides, it is not soon affected by Fire or Flame; if a Piece be held in the Flame of a Candle, till it be red hot, when you take it out you see no Alteration in its Transparency, or any other Property.—Though by a long Continuance in a very strong Fire, it will become calcined, and quite Opake, much resembling *Leaf Tin*.—I shall present my *Euphrosyne* with a choice Sample of this *Fossil Glass*, adhering to its native Earth, for her further Examination at Leisure, and by which she may prove not only the Experiments now mentioned, but many others at Pleasure,

Euphros. I see in this, as in most other noble Works of Nature, that their Formation was not a *Sportive Amusement* of Omnipotence, but beneficently intended to be subservient to the common wants and necessities of Mankind—I shall thankfully deposite your curious Present in my *Museum*.

Cleon. Your religious Reflection on *Final Causes* pleases me much my *Euphrosyne*; that is usually the *First Fruit* of true Philosophy—This brings to my Mind anew that wonderful Power we have, sometime ago, so largely contemplated, I mean ELECTRICITY—for since that Time many things have been discovered, both with respect to the Bodies in which it resides—the Uses that may be made of it for the real Benefit of Mankind—and the Means by which it is best administered for those salutary Purposes—

Euphros. I know by your Stile and Manner of Speaking, that I am to hear something further both in the *Philosophical* and *Medical Consideration* of this amazing Power.

Cleon. You are quite right in your Conjecture, my *Euphrosyne*.—Before, we only took Notice of the Power, and said very little of AMBER itself, as a *Fossil*, the most renowned of any in all Antiquity upon that Account—as to the *Origin* and *Nature of Amber*, it is scarcely yet known; but the most probable Account of it, is of Mineral Nature, a kind of *Bitumen*, that was once in a Fluid or very soft State, as is evinced by the Number of extraneous Objects observed in it, as *Straws*,
small

Small Insects, &c.—That it was hardened into the present State by a *Mineral Acid*, of the Nature of *Spirit of Sulphur, Oil of Vitrol, &c.* The native Colour of Amber is Yellow.—It is transparent to a considerable Degree—It is of a hard, compact Consistence—admits of a very high Polish—Is of an *Inflamable* Nature.—It is said to be soluble in certain Menstruums; but that is doubtful.—

Euphros. Pray *Cleonicus*, is there any other Fossil, or Body, remarkable for *Electricity*, besides *Amber* and *Glass*?

Cleon. There is, my *Euphrosyne*; and it is of late Discovery.—Indeed, it is more eminent than either of them, in respect of its *Electrical* Quality.—It is a Gem, or Jewel, which the Dutch Jewellers first discovered to have an Electric Power; for in heating it by grinding and polishing, they observed that it *attracted Ashes* and other light Bodies near it, and therefore called it the *Ashen Tracker*, but now it goes by the Name of *Tourmalin*.—As Electricity is of two Sorts, *Amber* possesses one and *Glass* the other; but the *Tourmalin* possesses them both, or rather, both Sorts may be excited in it.—The *Positive* on one Side, and the *Negative* on the other Side.—The Mode of exciting it in *Amber* and *Glass* is by *Rubbing*, but in the *Tourmalin* it is excited by *heating* it only.—Thus if it be heated by the Fire, or hot Water, one Side will *attract*, and the other *repel light Bodies*.—But as it is of small Bulk it will not afford these Powers in Quantities and Strength sufficient for Practical Uses—Therefore the *Tourmalin* is a *Singular Curiosity* only, and as such I here present my *Euphrosyne* with one to try Experiments upon, when she has nothing else to do.

Euphros. This is a *Precious Stone* indeed, *Cleonicus*; a Gem of intrinsic Value—such *Jewels* as these ornament the *Mind*, not the *Body*.—They truly decorate the Philosophic Part of our Sex—but Pray excuse a small Digression, *Cleonicus*, in what respects has *Electricity* been improved for *Medical Purposes* of late?

Cleon. The true Reason why *Electricity* was not so successfully applied to the Cure of Diseases formerly as it is now, was, because it was given in *too great Degrees of Force*; this was soon found to be the Case, and gave
Occasion

Occasion for the Invention of the ELECTROMETER, an Instrument adapted to the *Leyden Vial*, which measures and adjusts the *Electric Power*, or *Shock*, in any given Degree you please.—The *Shock* from the Vial itself, though in the lowest Degree, was by Experience soon found to be too great and sudden, for many particular Disorders, therefore Recourse was had to *Sparks* from the Conductor, and to the *electric Stream* issuing from the Point of a Metal Wire at the End of it—by a constant Application of these gentler Powers, the Success became more general and conspicuous.—But even here in some Cases the Force of the *Sparks* was found to be too great, and that of the *Stream* too weak; which gave rise to the Contrivance of giving the *Stream* through *obtuse Points of Wood*, instead of *Sharp Points* in Metal.—Thus a Power was obtained of an intermediate Degree between the other two.—And in many Diseases was found more Efficacious.—In many Disorders, an ELECTRIC CHAIR instead of the *Stool*, with four Glass Feet, was found much more convenient, and therefore is now substituted for it.—They have also much improved the *Amalgam* for the Cushion, by which means greater Quantities of *Electricity* are procured from the same Machine.—These, with many others of less Note, are the Means now used in *Medical Electricity*, and with surprising Success; especially in all Diseases proceeding from Obstructions in the fine Capillaries of the Vessels, which by the gentle Flux, and Strokes of the Electric Fluid are generally removed, the proper Circulation through the Parts restored, and the Health of the Patient of Course.—I suppose in another Age there will be a COLLEGE of ELECTRICIANS;—A DOCTOR OF ELECTRICITY in every City and Town;—And an *Electrical Machine and Apparatus* in every Gentleman's Family.—Perhaps, it may at last come to pass, that every Man may be his own *Electrician*, and the *Diplomatic Gentry* quite discarded.

Euphros. I am pleased to hear you arrange so agreeably on the great improvements and beneficial Application of ELECTRICITY in the Cure and Relief of *Invalids*.—I heartily wish it could be brought into a general Practice, and rendered (according to your *Prognosticks*)

no sticks) a safe, easy, and speedy Method of curing, or alleviating the many Disorders and Illnesses we are so liable to.

DIALOGUE III.

Of the MAGNET or LOADSTONE, Natural and Artificial. The NATURE of MAGNETISM, and its POLARITY, shewn by EXPERIMENTS. Of the NEEDLE and SEA-COMPASS. Of the VARIATION, and DIPPING of the Needle. Of a Central MAGNET in the EARTH.

Cleonicus.

THE *Fossil* I shall next describe to you, my *Euphrosyne*, is not only possessed of the most useful, but the most singular Property in Nature.

Euphros. And Pray, *Cleonicus*, what do you call this *Fossil*? and what is it's wonderful Property?

Cleon. It is the MAGNET or LOADSTONE, to which you are no great Stranger, my *Euphrosyne*.—You know it has the Singular Property of *attracting and repelling Iron*, but no other Body, unless it be it's own Substance.—That there are two Parts in every Magnet, called it's POLES, from one of which issues an *Attractive*, from the other, a *Repulsive Power*.—This is universally the Case in every Piece of Magnet, great or small.—That this Power is communicable to *Iron*, but to no other Substance.—That the Magnetic Iron is then called an *Artificial Magnet*, and acts in every respect like the *Natural Magnet*.—That this Power circulates from one Pole to the other on every side.—That therefore every Magnet is in the Center of a *Magnetic Vortex*, or Atmosphere of it's own Power.—And this I think will be necessary to shew you by Experiment.—You here see two Sheets of *Writing Paper*.

Euphros.

Euphros. I do; but I see nothing else, unless a few *Steel Filings* in a fine Sieve.

Cleon. These Filings I sift over the two Sheets of Paper,—and now what do you see, my *Euphrosyne*?

Euphros. I'll tell you what I see, *Cleonicus*.—I see you have cunningly concealed two Magnets under the two Sheets of Paper, and their Effects upon the Filings betray them.—They dispose and configure those Filings into the Forms of the *Vortexes* you just now mentioned. They shew the course which the Virtue takes flowing from Pole to Pole continually.—I shall discover your Magnets by taking up the Papers.—I find under one a *Natural Magnet*, but under the other an *Artificial one*.—By this curious Experiment, I see they have each the same Effect on the Filings.

Cleon. In the next Place, you see here a *Natural MAGNET* formed into a perfect *Globe*—This I put into a piece of Cork, and set it a swimming on the Surface of Water in the *Bason*—You see a black Line drawn on the Side of the Cork—then, when the Cork is at rest in the middle of the Water, you observe the *Position of the Straight Line* upon the Cork; and this my *Euphrosyne* will observe to be the Position of that Line, *invariably*, if the Experiment were tried a hundred Times over.—All this is to prove, *that every Magnet, in a Condition to move freely, will place itself in one and the same Position, with respect to the Points of the Compass, for many Years together without any sensible Alteration.*

Euphros. And what do you infer from this strange Property of the Magnet, *Cleonicus*?

Cleon. From such Experiments Mankind were first taught, that if an *Artificial Magnet*, or what is usually called a *Magnetic Needle*, has a brass Cap fixed in it's Center, with a conical Hole on the lower Side, by which it may, be suspended on the Point of a Pin in the Centre of a Circle divided into thirty-two equal Parts, then this Needle being truly equipoised, will, after several Vibrations to one Side and the other, settle itself in a Position directed to one of those Divisions on the Circle on each Side, or nearly so; and that this Position or

Direction

Direction of the Needle will be the same for a long time in the same Place.

Euphros. Pray, *Cleonicus*, are not these Divisions of the Circle you speak of, called the thirty-two *Points of the Compass*?

Cleon. Yes they are, my *Euphrosyne*; four of these, they mark with the Letters N, S and E, W, which are called the *Cardinal Points* of the *Horizon*, as they denote the NORTH and SOUTH, and EAST and WEST Points thereof.—This Circle the *Mariners* call the *Card*, and the Line which passes through the North (N) and South (S) Points they call the *Meridian Line* of the Card.—Now the Skilful Mariner always has it in his Power to find the *Position* of the *Meridian of the Place at Sea*, wherein his Ship is—consequently he can always tell the Difference between the two Meridians of the *Ship* and the *Card*; and this Difference is what they call the *Variation*, and estimate it by the *Number of Points* contained between them on the Card—Then the Variation of the Compass being known, he can *Steer* his Ship upon such a *Rumb*, or *Point of the Compass*, that her Course shall be constantly directed in such manner as to bring her to the Port for which she is bound.

Euphros. So I find the Noble and necessary Art of NAVIGATION depends entirely upon the MAGNET, or the *Variation of the Needle* occasioned thereby, and as this is a Matter of such prodigious Consequence, I should be glad if I could see you illustrate the Method of finding this Magnetic Variation in some Way that I could understand without much Difficulty.

Cleon. That I can easily do, my *Euphrosyne*—see here is a *Card*, with its thirty-two Points pasted on Pastboard; and another lesser one in Paper, freely moving upon it about a Pin in the Center of each—so that the Points of the smaller moveable Card may be placed to any Points of the Pastboard at Pleasure.—Let this larger Card be supposed fixed, or to represent the *Horizon* of the Place of the Ship.—For every Day in the Year, and for any Latitude or Place of the Ship, the Point of the Compass on which the Sun rises that Morning is known from proper Tables calculated for that Purpose—and the Point

Point on the Card or Compass is given by Observation—therefore the Difference, or *Variation* is known in Degrees and Minutes.—For Example, suppose in the Ship, he knows the Sun will rise on a given Day, at the Distance of *one Point*, (or $11^{\circ} 15'$) from the *East* towards the South, but by observing the Moment of its Rising on the Compass, he finds it to be three Points from the East towards the South (or $33^{\circ} 45'$) then it is evident, the *East Point* of the real *Horizon* of that Place is distant two Points from the East Point on the Card, and consequently, that the *Variation* is there $22^{\circ} 30'$.

Euphros. I thank you, *Cleonicus*; you have made this Matter very clear to me—Pray is this *Variation* of the *Needle* in it's self *variable*, because you say it will continue without *sensible Alteration* many Years?

Cleon. The *Variation* is *variable*, or the Situation, and Direction of the Needle in any one Place, gradually alters, so as in a Course of Years, to become sensible.—Thus at London the *Variation* was a whole Point to the East about an hundred Years ago.—After that it veered to the North, and at last came precisely into the Plane of the *Meridian* of London, so that then there was *no Variation* at all.—Ever since then it has been veering Westward, and is now more than twenty one Degrees to the *Westward* of our Meridian.—But this proves no Impediment to Navigation, because if the Quantity of it be known at any time, it is all that is required—in making Needles magnetical, they are obliged to make the *North Part* somewhat *lighter* than the *Southern Part*, for else it would not stand level, but *Dip* below the Horizon—but this *Dipping* of the Needle and the *Variation*, is the same thing; only, the former is in a Vertical Plane, but the latter in a *Horizontal one*.—The Needle *dips* with us about seventy Degrees below the Horizon.—But this *Dipping* of the Needle is of no Use to Mariners, because made in the Plane of the *Meridian*.

Euphros. Pray, *Cleonicus*, in what manner do you communicate this Virtue to the Needle most effectually.

Cleon. In this Affair, three things are very carefully to be observed.—First, that it be touched by an *Artificial Magnet*,
as

as the Power is much greater, than in a *Natural one*.—*Secondly*, that each End of the Needle be touched at the same time; the *North End* of the Needle by the *South Pole* of the Magnet; and the *South End* of the Needle by the *North Pole* of the Magnet.—*Thirdly*, that in touching, the Magnets are drawn from the *Middle to the Ends of the Needle* always—This last Caution is necessary, because what is gained by drawing the Magnet one way, is lost by drawing it the contrary way, as is known by Experience.—And the Second Precaution is necessary, because the *same Polar Virtue* in the Ends of the Magnet and Needle makes them repel each other, and consequently the End of the Needle that was touched by the South Pole of the Magnet, will be repelled afterwards by it, as you will easily find by experiment.

Euphras. Pray, can you any way conceive what Alteration is made in the Needle by touching it, *Cleonicus*?

Cleon. I shall shew you an Experiment by which you will be better able to judge of that Matter.—I fill this shallow Brass Dish with fine *Steel Filings* to the Rim, and shake them together till their Surface be level —Then I apply the North Pole of the Magnet to the outside of the Bottom of the Dish, and draw it three or four times across through the Center, always the same way from *South to North*.—In each Stroke you observe the Filings rise over the Magnet, stand upright, then fall the contrary way, or to the South.—The Filings in this Tract become a Magnet, and conduct the Magnetic Power through them from End to End, as any other Magnet does.—While the Filings that lie in the Dish on each Side the Magnetic Tract have no *Magnetic Power* at all.—This Experiment shews the Difference between the Particles that *are*, and those that *are not Magnetic*.—The Magnetic Particles in the Tract, are regularly disposed and connected by their opposite Poles throughout, as appears to the Eye, by their lying all in *one Direction*.—Those which are not Magnetical lie promiscuously one among another, without any Order at all.—It is further observable, that the End of the Tract, to-
wards

wards which the Filings point, will repel the *South End* of the Needle, and thereby prove itself to be the *North Pole* of the Filings.

Euphros. A very curious and convincing Experiment, this—I now am satisfied in what manner the Particles of Artificial Magnets must be affected in Touching, to become Needles—I see also why the *Magnet* and the Needle mutually affect each other, while they are within each others Power.—But still one Difficulty remains, *Cleonicus*, and that is, when the Needle is at Sea, and no Magnet near it, what then, and there should cause any Difference in the *Variation*, or make that variable in itself.

Cleon. Something there must be some where to actuate the Needle at Sea, as you justly observe, my *Euphrosyne*; but nothing can affect the Needle that is absolutely invisible but *Magnetism*.—It is therefore evident that nothing besides the Earth itself can be the Magnet in question; since a *Magnetic Vortex* from the Earth alone, can be sufficient to account for the *Phænomena* of the Needle on every Part of it's Surface—but the *Poles* of it's *Magnetism* can never be in the *Poles* of the *Globe*, or in the Ends of it's Axis, because in that Case there could be no *Variation* of the Needle, but a *Dipping* only.—Neither can they be *fixed* in any other Part of the Earth's Surface, for in such Case there would be a *constant Variation* in the same Place.—There must, therefore, necessarily be an *Internal Magnet* in the Earth, which is *moveable*, and constantly altering it's Position or Direction of its Axis.—Thus I think all the *Phænomena* are fairly proved for *Magnetism*, and the *Magnetic Needle*.

Euphros. I think so too, if I may be allowed to judge of such Sublime Subjects—but, pray *Cleonicus*, how do you estimate the *Strength* or *Goodness* of *Natural Magnets*?

Cleon. By their *Blackness*, *Hardness*, *Ponderosity*, and the *Weight* they will lift compared with their own *Weight*.—For taking up *Weights*, they are mounted in the manner you see this in my Hand, which I shall present my *Euphrosyne* with.—It will take up twenty times it's own *Weight*, which is reckoned very good.—Some will take up thirty times their *Weight*, but they are rare to

be found.—The smaller the Loadstone, the greater it's Strength in Proportion.—I once saw a *Miracle of a Magnet*, it weighed barely three Grains, and lifted with it a piece of Iron two hundred and forty-seven times it's own Weight.—What wonderful Powers there are in Nature.—Our Earth is environed with no less than four Atmospheres of these invisible Powers; one of ÆTHER, another of AIR, a third of ELECTRICITY, and a fourth of MAGNETISM, constantly flowing from one Magnetic Pole to the other, over all the Surface of the Earth.

D I A L O G U E IV.

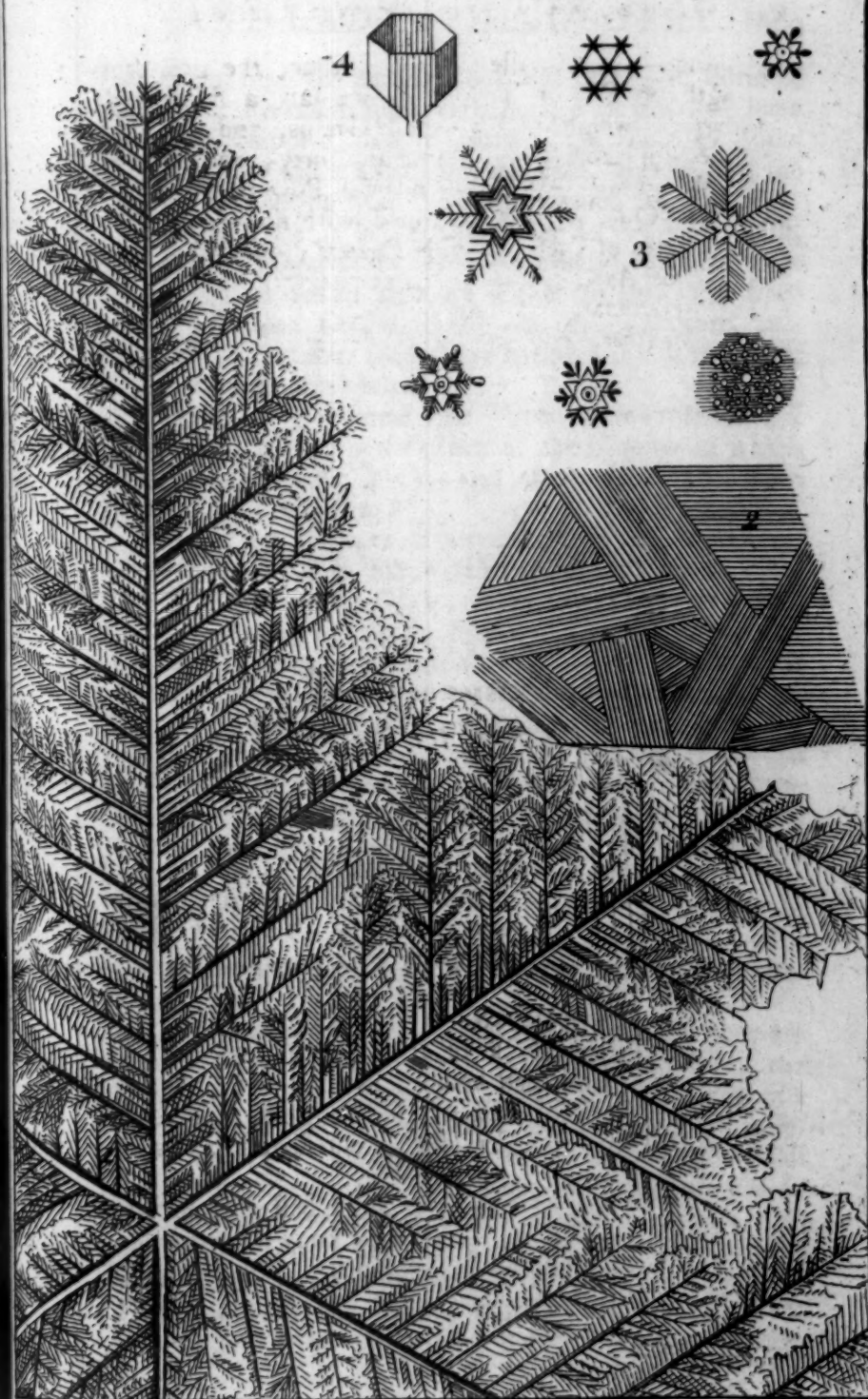
Of the NATURE, FORM, and wonderful PROPERTIES of ISLAND CRYSTAL. Of it's double and Multiple REFRACTION. The PARALLEL SURFACES and PRISMS highly Polished. The numerous IMAGES made of the same OBJECT.

Cleonicus.

WE are now arrived, in the Course of our Survey, to the Contemplation of the fairest and most delicate *Fossil* the Earth affords, and of the greatest Celebrity among *Philosophers* as well as *Naturalists* for its singular and amazing Property of a DOUBLE REFRACTION of LIGHT.

Euphros. I suppose you mean ISLAND CRYSTAL, as I have heard you speak of its wonderful Property of a DOUBLE REFRACTION before now; but of this my Ideas are very imperfect, and should be glad, *Cleonicus*, if you would be at the Trouble to elucidate this Matter to me.

Cleon. I'll endeavour to do it in the best manner I can. First then, my *Euphrosyne*, you must know that this *Island Crystal* is in common Appearance, much like other Crystals, pellucid and clear as Water.—It also grows
like



The Fern
 VEGETABLE CRYSTALLIZATION
 of Water in
 ICE, SNOW, FROST, &c.

like them from the hardest Rock and Stone, in Form of *Hexagonal Pyramids*, with very sharp Points.—I have here two Samples, one of *common*, the other of *Island Crystal*,—they differ a little in their Hue, you see, but the Manner of shooting from the Stone is much the same.

Euphros. I see it is; but these are as yet very small, *Cleonicus*; I suppose they grow to a much larger Size?

Cleon. You see an Instance of that in this large Specimen of *Island Crystal*, lying one upon another, and some of the *Pyramids* four or five Inches wide at the Base, and six or seven Inches long.

Euphros. A wonderful fine View of them indeed; I have hereby a most perfect Idea of the Manner in which it *vegetates* from the Rock—and what am I next to learn concerning it, *Cleonicus*?

Cleon. That when these large Crystals are broken off the Stone, and into many different Pieces, each Piece (whether large or small) is precisely of the same Form, or *quadrangular*, having *six Sides*; and the two opposite ones exactly parallel to each other.—But on every Side the two opposite Angles are equal, in each Diagonal.—But in one Diagonal they are *acute*, and in the other *obtuse*, or the Figure of each Surface is a *Rhombus*.—So that no Side of the Piece can be perpendicular to the Plane on which it lies, but must *lean*, or *incline* towards it.—Here is a curious regular Piece, which will evince all I have said by barely inspecting it.

Euphros. This is a fine Piece, indeed; I perceive in it the Truth of every Article you mentioned.—But pray, *Cleonicus*, has every Piece the same Form and Attributes?

Cleon. The very same, my *Euphrosyne*, whether they are large or small, thick or thin, still the Figure is all the same.—And from thence it is manifest, that any one Piece (or *Rhombus*) is resolvable into others, in an indefinite Degree—This you see in the numberless small Pieces contained in this little Box, which I desire you to keep, and examine them at your leisure.

Euphros. That I shall certainly do, *Cleonicus*; what a wonderful *Contexture* this demonstrates in *Island Crystal*.—Thus much for the Form; now for that peculiar Pro-

perty of *double Refraction*, pray, what am I to understand by it?

Cleon. Only this, that a *Beam of Light* instead of passing through it singly and intire as in *Glass*, is divided into *two or more Beams of Light*; and the Object viewed by the said Light, is divided in like manner into *two or more Objects*.——*Naturalists* have hitherto considered only *two Refracted Beams* in this Crystal.——But having the Curiosity to grind and polish several Pieces into the Form of *Prisms*, I soon by that Means discovered, that the Refraction was not only *double*, but *Manifold*.——And that a Variety of *Prisms* produced a great Variety of *Refractions*, and presented as great a Number of Images to the View of one and the same Object.——Thus some would show but *two Images*, some *three, four, six, twelve, sixteen, twenty* Images and more, which demonstrated there was a Refraction of one Beam of Light into as many different Parts.——Nor is this all; each Image is at the same time tinged with a Variety of *Prismatic Colours*, some of which are intensely strong and bright, when the Object is luminous as the *Window, Candle, Sun, &c.*

Euphros. Well, *Cleonicus*, you have set me a longing to see such strange Phænomena.——I observe you have a great many Pieces, and *Prisms* in that *Shagreen Box*, which I suppose are designed for my Entertainment to Day.

Cleon. They are so, my *Euphrosyne*, but I shall first shew you the common double Refraction through a Piece of *Parallel Crystal*, in its *pure Natural State*.——To make this Matter as evident as possible, I shall chuse for an Object a small *Circle*, for which Purpose, the Letter O will serve very well—this Letter, by the double Refraction, will appear *double*, or *two Circles*, and they will nearly represent the Figure of *Eight 8*.——Then by turning the Crystal round, you will observe that Figure to move round also—sometimes it will be in this upright Position 8; sometimes in a Horizontal One ∞ .——In short it will have every Position in moving quite round.——There, try the Experiment yourself.

Euphros. I will—I see the Letter O double—nearly like the Figure 8.——By moving the Crystal round, I see that Figure moving in every Position, as you say.——

It

It is very surprising indeed, that two Images should appear of one Object.—But pray, *Cleonicus*, do both these Images move, or only one of them about the other?—I can scarcely tell by observing them.——

Cleon. The latter Query is the Case, one Image only moves about the other, which is fixed.——This I shall shew you by a demonstrative Experiment, in a small Apparatus fitted to the Microscope for that Purpose, and is no more than a Circular Piece of Brass, with a small Hole in the Middle for a luminous Object.——This is placed in the under Part of the Stage that has the *Wheel and Pinion*.——And on the upper Part is fixed a Piece of Crystal by means of Cork.——Then the double Microscope, with a Micrometer in its Focus is placed over it, to view the two Images of the said Hole.——And when the Pinion is turned, the Image of the Hole by direct Rays appears fixed on the Threads of the Micrometer, while the other is seen to move about it in a Circle at a small Distance.—There, my *Euphrosyne*, view the Phænomenon.

Euphros. This I shall do with great Readiness—I see the two luminous circular Images extremely distinct—and when I turn the Pinion, one moves about the other as a Center just as you said.——But the moveable one I see is a little tinged with Colours, how happens that, *Cleonicus*?

Cleon. The fixed central Image is free from Colours, because it is made by direct Rays—but the other will be a little tinged, because made by an *Oblique Refraction*, somewhat like that by a Prism; and which Sir ISAAC NEWTON calls the *unusual Refraction*.——If you view a small *Right Line* instead of a Circle, you will see the Images of two Lines, sometimes at a great Distance, sometimes at a less, and in one Case, where the circulating Line coincides with the fixed one, they both appear as one single Line.

Euphros. This I easily apprehend, but shall try the Experiment when at leisure.—Pray, *Cleonicus*, as you mentioned a *Multiple Refraction*, I suppose you mean, that some Pieces of Crystal have a *Triple* or *Quadruple Refraction*.

Cleon. They have both, my *Euphrosyne*, in their Natural Form, with *parallel Surfaces*.——Almost all fine Pieces

have a *Triple Refraction* or form *three Images* of an Object. Here are many that will convince you of it when I have put to the Window Shutters, and range for a *Candle*, for these Experiments are best shewn by *Candle-Light*.—The Candle is brought, now view it through this Piece.—

Euphros. I do; I see three Candles perfectly well formed. —The middle one, without any Colour at all—but the other two, are very much tinged with Colours, as if they were refracted through a Prism.

Cleon. The Case is but little different, for the two outside Images are formed by two *unusual Refractions*, which are so very oblique, that they tinge as much as a thin Prism would do.—In some Pieces of *Parallel Crystal*, you will find this *Triple Refraction* changed into a *Quadruple One*, by splitting the *direct Beam* itself into two; and consequently the middle Image, (which before was *colourless*,) into two; so that now, four Images of the Candle appear—View them my *Euphrosyne*.

Euphros. I see all the four Candles; and can plainly perceive it is the middle one divided into two, which are very little coloured.—Pray, *Cleonius*, what Appearances arise from a Candle viewed through a Prism of *Island Crystal*?

Cleon. I have here a Variety of them to gratify your Curiosity, as far as I can.—No Prism of this Sort shews less than two Candles, some four, and others by Composition, shew *six, eight, twelve, sixteen, twenty, &c.*—In the *Prisms*, the Refraction is very great, and very strongly coloured.—I have placed four different Prisms in a long Box, with proper Apertures for each.—Please to view the Candle through them.—

Euphros. I will.—In the first I see two Images greatly coloured.—In the second I see four Images.—In the third, no less than *six*—And in the fourth, I know not how many, I can tell ten or eleven.—

Cleon. And in the last, precisely twelve, as you will find when a little more used to look at them.—Those Prisms that shew more than two or four Candles, do it by Composition.—Thus if I take two unequal Prisms that have a *double Refraction*, or shew two Images singly, they will, if put together in an *inverted Position*, shew four Images.—

ges.—If a Prism of a double, and another of a Triple Refraction, be so combined, they will exhibit six Images—And thus greater Numbers are produced.—Now in all Island Crystal, there are easily discerned many *Fissures* running across it, in Directions not parallel to any of its Sides, as in this curious Specimen you see here,—

Euphros. I see them very numerous—all with coloured Light reflected from their Surfaces;—they make a very fine Phenomenon indeed, *Cleonicus*.

Cleon. Now one of these *Fissures* sometimes happens in one of these Prisms, and so situated as to divide it into two unequal Prisms, then the Prism becomes a Compound One, and exhibits a Number of Images as I said before.—By a single Prism of three Refractions combined with a Compound Prism, you may encrease the Number of Images to an incredible Degree,—but as *Faith* is rather a Fault in Philosophy, I will convince you by a plain Fact.—You see here a Compound Prism in which I can plainly number sixteen Images—see, my *Euphrosyne*, how many you can tell,—

Euphros. I can see but fourteen or fifteen at most.—I think that a great many—they make a most brilliant Appearance by their Number and Colours.

Cleon. With this Prism I combine one with a Triple Refraction.—And now my *Euphrosyne*, behold the Effect.—

Euphros. Dear me how surprizing is the Sight!—I see no less than three Companies of Images, Rank and File, in which there are at least near fifty in Number—how strangely are they tinged!—some Flames all over Green, some all Blue, Indigo, Purple, &c. such Resplendency I never saw before—no *Chandler* can compare with it.—

Cleon. This Effect, wonderful as it is, may be produced in one entire Piece of Crystal formed into a Prism at each End.—But here is a Piece of Parallel Crystal that shews no less than seventeen Images of itself, without any prismatic Form—look through it.—

Euphros. I do—I see three in the Middle, and seven on each Side very plainly—Pray how do you account for this, *Cleonicus*?

Cleon. As yet I cannot Account for it at all—And where *Mystery begins, there Philosophy must end.*—You must be content with what you have seen, and with the *Specimens* I leave with you, for Amusement, and a *matchless Treasure* for your *Museum*.

DIALOGUE V.

Of ASBESTOS or AMIANTHUS; *Its wonderful Nature and Property of resisting the FORCE OF FIRE.*
Of Incumbustible CLOTH. — Of MUNDICS. —
Of GEMS or Precious STONES.—Of other MINERAL BODIES.

Cleonicus.

THE *Fossils* we propose to examine, must be possessed of some singular and extraordinary Qualities and Characters; and in this respect, that strange and surprising Property of *resisting the Force of the strongest Fire*, peculiar to the ASBESTOS, renders it a Subject worthy the greatest Notoriety and Admiration.—Of this, my *Euphrosyne*, see here a Choice and selected Specimen.—

Euphros. As you hold it, *Cleonicus*, I see nothing remarkable in its Appearance—it seems to be a common *Fossil Stone*.—But its Property of resisting the *Force of Fire*, is not the Object of Sight.—

Cleon. Well, then I will turn the other Side upwards to your View; and will that please my *Euphrosyne*?

Euphros. Good Luck! what a wonderful Difference in the View of the two Sides.—How delicate and beautiful a Surface is now exhibited—It appears like the finest Green Silk, or *Satin*.—Sure it is a Sort of *petrified Cotton or Silk*.—I see very plainly, *silky Filaments* run through the whole Length, and compose the whole Surface.—Pray, *Cleonicus*, what gives it that fine charming Gloss, I see?

Cleon.

Cleon. That is owing to the *Firmness* of its *Texture*, and the *natural Polish* of its *Fibres*.—But now you see I raise up those *Fibres* or *filky Filaments* with the *Point* of a *Needle*, and then they appear quite of a different *Form* and *Colour*.—It is now a *Parcel* of the softest *filky Substance* you can see, and *whiter* than the *whitest Cotton*.—Only feel it, my *Euphrosyne*.—

Ephros. Why, it is so very soft and *filky*, that I am scarcely sensible I touch any thing.—Sure, *Cleonicus*, this might very easily be wrought into a *Web* of fine *Silk Stuffs*, and so make *Garments* of it.

Cleon. The *Ancients* had the *Art* of doing this, and so have the *Moderns*.—But the *Misfortune* is, there is not enough of this finer *Sort* you see, to supply proper *Materials* for such a *Manufacture* of *Cloth*.—And even this being of a *brittle Nature*, breaks into short *Threads*, and unless it were woven with fine *Flax* mixt with it, you could hardly make *Cloth* of it at all.—And another thing is, that you cannot make a very fine *Thread* by mixing the *Asbestos* and *Flax* together.—And when the *Cloth* is made, it must be put into the *Fire* to burn away all the *Flax*, and so leave a pure *Amianthus*, or *incumbustible Cloth*.

Euphros. That is almost a *Pity*, because when our *Gloves*, *Stockings*, &c. were foul, we should be able to *cleanse* them by only throwing them into the *Fire*, which would save a deal of *Expence* and *Trouble* in *Washing*.—Pray *Cleonicus*, have you ever seen any of this extraordinary *Cloth*?

Cleon. Yes, many a *Piece*, my *Euphrosyne*; I once had a *Purse* made of it, which was a *Present* to my *Grand-Father* from *Italy*; where the best *Fossils* of this *Sort* are found; and where, of *Course*, the best *Cloth* is made.—I have brought you a *Piece* of the most *Superfine* I could get, and is coarse enough too.—But it will do well for you to try *Experiments* withal, to entertain yourself or a *Friend* at any time.—And without both the *Fossil* and the *Cloth*, your *Museum* would after all be very defective. We have much of this *Fossil* in *England*, but of an inferior *Nature*, and of very little *Value*.—The most valuable

luable Fossils of every Kind, except *Mundies*, are found in the *hotter Regions* of the Earth.

Euphros. And pray, *Cleonicus*, what is that Substance you call *Mundic*?

Cleon. *MUNDIE* is a Species of that Sort of Marcasite, that is chiefly remarkable for its great Variety of the most intense, glorious, and glowing Colours that are to be found in Nature.—*Mundic* may be said to wear the *rich Livery* of the DEITY, there being no Bodies of the Animal or Vegetable Class, whose *Resulgence* is comparable to that of the finest Sort of *Mundic*.—Its resplendent Colours are innate and permanent.—They are heightened to a Degree not to be conceived without seeing them.—They have the greatest Variety of all *Prismatic Colours* in deeper Dyes than in any other Bodies we know.—The *Red, Orange, Yellow, Green, Blue, Indigo, Purple, Violet*, and every other Hue we know of.—The more they are magnified, the stronger they appear—and when they are properly placed in the *Opake Solar Microscope*, and magnified about forty times in Diameter, they exhibit such Scenes of Glory, as are perfectly ineffable, and cannot be conceived without viewing them.—Almost every one that first beholds them exclaims, *What heavenly Views are these!*—The first fine Day that happens, my *Euphrosyne*, I shall display many of these *Celestial Prospects* to your ravished Sight.—At the same time I shall shew you the Structure of another Form of an *Opake Solar Microscope*, much better adapted to expose the amazing fine Texture of these and all other Mineral Bodies.

Euphros. I shall be impatient till Heaven shall favour us with another clear Sun.—In the mean time, *Cleonicus*, you will proceed in your *Review of Fossils*.

Cleon. The next Class of Fossils are those the World so much admire under the Epithets of *JEWELS, GEMS, and PRECIOUS STONES*.—It is no wonder, when we consider what a Degree of *Transparency, Variety of Brilliant Colours, Hardness* of the Substance, and *Scarcity* of the Subject, is found in most of them.—The *CRYSTAL* may be reckoned among the first of these, as being the most common; it is a perfectly colourless, transparent,
and

and very hard Stone, growing from the Rocks in a *pyramidical Form* in general, and sometimes it is found in the Form of a *Pebble*, as the *Brasil Pebble*, &c.—The AGATE has had the honour of being ranked among *precious Stones*, (but for very little Reason, as it is too common,) for the most Part opake, and variegated with Colours in a curious and irregular Manner.—The JASPER is found in form of a *Flint* or *PEBBLE*; and, when wrought, appears of a beautiful *Green*, spotted with *White Clouds* sometimes, and is scarcely *pellucid*, unless very thin.—The EMERALD is in form of a *Pebble*, and sometimes of *Crystal*; both Sorts, when polished, appear of the finest *Green*, in all different Shades, from very dark to extremely pale.—Those of the *Pebble Sort* are very *bright* and *transparent*, but not glossy as the *Crystalline*.—The CARNELIAN, SARDA, or SARDIUS, all Names of the same GEM; found in *Pebble Forms*, and when polished, appears of a *Flesh Colour*, though some are *whitish*, and others *Blood-red*; and some beautifully variegated, and veined with pale Red and White.—ONYX is a precious Stone or Gem, as it were, half transparent; formed in Zones about a central Body, and is not inferior to other semi-opake Gems in lustre and brightness.—The Rings or Zones are a distinguished Beauty to this Stone, which admits of a very high Polish.—The SARDONYX is a semi-transparent Gem, which partakes of the Nature of the *Sardius* in its *Flesh Colour*, and of the *Onyx*, in its zoned or tabulated Form.—It is distinguished into Species, according to its great Variety of *Tinges*, *Zones*, &c.—The TOPAZ is always found in an oblong *Pebble Form*, and was called the *Chrysolite* among the Ancients, for its *Golden Colour*, in which it excells all the other Gems; but it has all Degrees of *Tinges* from very deep to very pale; it is esteemed so valuable, that it is said the Great Mogul has one worth 20,000 Pounds.—SAPPHIRE is the most singular and beautiful of all Gems for its noble *Azure*, or *Sky coloured Blue*.—They are sometimes found in Shape of *Pebbles*, and sometimes in that of *Columnar Crystals*, with short pyramidical Tops.—They are of the *palest Tinge* to the deepest *Indigo*; the *Pebble Sort* are the best, and of exceeding Value.—The RUBY is a Gem of great Rank and Renown

Renown for its celebrated fine glowing Red Colour, and Hardness; it is always found in the Shape of small oblong flattish Pebbles.—And one of ten Carats, is worth 216 Pounds, if of the best Sort and Colour.—They oftentimes have a *Native Polish* so perfect as not to need the Jewelers Aid.—The CARBUNCLE is only a Species of the *Ruby* kind; it is so called, because when held up to the Sun, it resembles in Colour a glowing Charcoal.—BERYL is a finer Sort of *Crystal* of the *Columnar-Form*, but it is also found in Pebbles, though not so common, nor so good: It is remarkable for a *fine Bluish Green Colour*, which it never looses, or changes.—The JACINTH or HYACINTH is a Gem of the pellucid Sort, of a *Red Colour* with a Mixture of Yellow; like most others, it is found in Form of a *Pebble* or of *columnar Crystal*.—It has a great Variety in its Tinges from the *Ruby* to the *Amber*.—AMETHYST is a Stone of a beautiful Colour, being a mixture of *Red* and *Blue*, which give all Degrees of a *Purple Hue*; it is found in form of *Pebbles* and *Crystal*.—The GARNET is a Gem of a *deep Red Colour*, with a cast of *Blue*; but variable in its Tinges, down to a *Flesh Colour*; It is extremely subject to flaws and blemishes,—It does not loose its Colour in Fire, like other Gems.—It is always found in the *Pebble Form*.—ADAMANT, or DIAMOND, is the *Principal* of all Precious Stones; it excels every Body in Nature in two respects; the first is *Hardness*, the second the *Power of Refracting Light*; it is cut and polished by its own Substance only, reduced to fine Powder: no other Body will touch it; it exceeds the *Power of Refracting Light* in Glass or Crystal, nearly in the Proportion of five to one and a half, or ten to three.—No Wonder so great a Power of Refraction should render it so Brilliant and Sparkling, and of such prodigious Value.—The Great MOGUL has the largest in the World, weighing two hundred and seventy-nine Carats, or two Ounces and a quarter, worth seven hundred, seventy-nine thousand, two hundred and forty-four Pounds.—It is found in various Forms of Crystal, and Crystalline Pebbles, with several irregular Sides or Faces, which have often a *Native Polish*—The Heat of common Fire does not affect it.—It is the Produce of
the

the *East-Indies* and other Parts of the Torrid Zone, as all the best Sort of precious Stones are.

Euphros. Well, *Cleonicus*, you will set me to reading on these Subjects, for I shall not remember half what you have told me—But pray, after these extraordinary Fossils, are there any other worth the Notice of a *Female Connoisseur*.

Cleon. There are many others of great Note and Use in Medicine, Arts, and Trades: but of little concern to the Public in general—Thus the LAPIS LAZULI, is a Stone of which is made that finest of Blue Colours called *Ultramarine*—Also the TURQUOISE STONE sometimes reckoned among the Gems.—BISMUTH, and ZINK, so much used in Gold and Silver *Soldering*—ANTIMONY, remarkable for its Use in Medicine—*NATIVE CINNABAR*, which is a Sort of *Mercurial Ore*, as they Obtain *Mercury* from it.—SULPHUR, the most inflammable Substance in Nature, and of the greatest Use in Medicine, and common Life.—BITUMEN, of a Pitchy Sulphureous Nature.—ASPHALTOS is also of a bituminous Quality. NAPHTHA, a liquid Bitumen, very inflammable, and hard to be extinguished.—PETROLEUM, a Sulphureous Oil, distilling from the *Clefts* of Rocks.—ARSENIC, a Mineral of a most *Poisonous* Quality.—SALTS of many kinds, as *Alum*, *Sal Armoniac*, *Nitre*, *Borax*, *Sal-Gem*, &c.—VITRIOLS of many Sorts, *Blue*, *Green*, *Red*, *White*, &c.—But after all, nothing will edify my *Euphrosyne* in this Science of Minerals so effectually, as a real Inspection of Specimens of the best in each kind, and the Names wrote on Slips of Paper pasted on them, to distinguish them; and of these I shall procure very soon, as large a Variety as I possibly can to garnish her *Museum* withal.

DIALOGUE VI.

Of ORES; the Method of extracting their METALS;
 the Properties of GOLD, SILVER, COPPER, IRON,
 TIN, LEAD, and MERCURY.—Of Factitious
 METALS, BRASS, STEEL, PEWTER, TIN-PLATES.
 —Of PLATINA;

Cleonicus.

WE are, at length, arrived to the last, but most
Capital Part of our SURVEY of Fossil and Mi-
 neral Bodies, and that is, to the Consideration of ORES
 and METALS.—For what, my *Euphrosyne*, would all the
Gems of the *Indies* avail us if we had not *Money* to pur-
 chase them?—Our *Money* is made of those *Precious Me-*
tals, *Gold*, *Silver*, and *Copper*, while *Iron*, *Tin*, *Lead*,
 and *Mercury* supply us with all the *Utenfils* of domes-
 tic Life and Business.

Euphros. Pray, *Cleonicus*, what do you call ORE?

Cleon. It is a hard Mineral Stone, either *Rock* or *Pe-
 ble*, which is impregnated more or less with Particles of
Metal; and these being separated from the Earthy Part,
 are melted into a Solid Body or Mass of Pure *Metal*.

Euphros. Could you just hint to me the Method they
 take to do this, *Cleonicus*?

Cleon. The Miners have *Stamping-Mills* for this Pur-
 pose; which by constantly *Stamping* the Mineral Lumps,
 break them into smaller and smaller Pieces, till at last
 they reduce it to a mere Mineral Dust or Powder.—This
 Powder is carried by a Stream of Water from the Mill
 over several Platforms of Wood, lying one below another,
 upon

upon a gradual Descent, and thus upon each Platform the Powdered Mineral lodges, according to the Size and Weight of the Particles, till that on the lowest Part becomes as fine as is necessary.—This pulverized Ore they carry to the *Smelting House*, where it is put into a large Furnace, with a proper *Flux* to promote the Fusion, and there, by the Force of Fire, it is melted, and sinks to the Bottom in a *Fluid State*, while the Earthy Part all rises to the Top, as being much lighter.—Lastly, the melted Metal at the Bottom is drained off into proper Vessels, where it gradually consolidates by Cold in the hard massy Substance of the METAL, in the Forms of *Blocks, Ingots, &c.*

Euphros. I thank you for this sketch of the Process of *Smelting, Cleonicus*.—I think I have heard some of those Ores afford exceeding fine Objects for the Microscope. —

Cleon. Most exquisitely fine are those of *Silver* and *Copper*, but of other Metals the Ores are in that respect not considerable.—The various Vegetation and Shooting of Silver through the whole Substance of the Ore, in all Sorts of Configurations like Sprigs, Branches, Fern-Leaves, &c. is wondrous curious to behold with the naked Eye, and much more so, by the Microscope.—The Piece you here see, is the richest that the celebrated Mine of *Potosi* produces.—This, with many more, are designed to enrich my *Euphrosyne's Museum*.

Euphros. And, pray, what makes *Copper Ore* so remarkably fine for the Microscope?

Cleon. The great Variety of incomparably fine Colours in many Specimens, though not in all—It is Copper in general that tinges most *Marcasites* or *Mundics, Crystals, Precious Stones, &c.* with their richest Dyes of *Green, Blue, and Purples*, of every Hue.—The Specimens of this kind are as beautiful as numerous, which are intended for your Repository; and all wrote upon, to distinguish them from *Mundics, &c.*

Euphros. You accumulate Presents upon Presents so fast, *Cleonicus*, that my little Collection will be of very great Value by and by.—But, pray, how many different

ferent METALS may you produce from Ores of every Sort?

Cleon. From those properly called *Metallick Ores*, only *Seven Metals* are produced, and they are *Gold, Silver, Copper, Iron, Tin, Lead, and Mercury*.—These all agree in the common *Definition* and *Characteristic* of METAL, which is, that it is a *hard, shining mineral Body*; *fusible* in various Degrees of Heat, mostly that of Fire; *Concrescible* by Cold; *Malleable*, or *ductile* under the Hammer; and is the heaviest of all Bodies.

Euphros. I suppose by your mentioning GOLD first, it is the *Principal* of all Metals.

Cleon. It is; and its *Characteristic* Properties are as follow—It is the most *Pure* of all compound Bodies—It is also the *Heaviest* of all, being $19\frac{1}{2}$ times heavier than Water.—It is most *Ductile* or *Malleable* of all Metals.—It is *Fusible* in the Fire—But is *more fixed*, or looses less in the Fire than any Metal.—It is *Yellow* by *Reflected Light*; and of an *Azure Colour* by *Refracted Light* through the thin Leaves thereof.—It is dissolvable only in *Aqua Regia*, and Mercury—It has an *Obtuse Sound*—It is sometimes, though rarely, found in *Ore*; sometimes in its *Native State*, in large Clods of *Pure Gold*; but most commonly in small Grains or Dust in the Sand of many Rivers on the *Gold-Coast* of *Guinea*, and other Places.

Euphros. Please next to tell me what are the peculiar Properties of *Silver, Cleonicus*.

Cleon. SILVER is the most *pure, fixed, and ductile*, of all Metals after Gold.—It's *Colour* is the most *perfect White*—It is $10\frac{1}{2}$ times heavier than Water.—It discovers more of a *Vegetable* and *Arborescent Configuration*, both in it's *native and dissolved State*, than any other Metal—It is dissolvable into a pellucid Fluid, by *Aqua Fortis*, and is *colourless*.

Euphros. I think you mention *Copper* as the third in Order and Value of Metals—Pray what are its specific Properties?

Cleon. COPPER has only one Property that principally distinguishes it, and that is, it's *Sound*; it being the most sonorous

sonorous of all the Metals.—It is of a *Red or deep Purple Colour*—but gives a fine Blue to a Solution of it—and also to the Crystals, which precipitate to the Bottom—Its Weight compared to Water is nearly as *nine to one*—It is mostly found in a very hard Stone of a dark Colour, running in Veins or Loads, between Beds or Layers of Rocky Earth or Stone.—It is sometimes found in its *pure Native Form*, and perfectly Malleable—Sometimes it appears to have a *Vegetative Power* of shooting Twigs and Branches—And very commonly it exudes in the Mine in form of Blue pointed shining Crystals, in large Heads of six or eight Inches wide, glorious to behold.

Euphros. You will now please to rehearse to me the Properties of *Iron, Cleonicus*, which you mentioned after *Copper*.

Cleon. IRON is the *hardest of all Metals*—It is *fusible* but with the greatest Heat—Is *malleable and ductile* with a common red Heat—May be hammered till it becomes *red hot*—Is the only Body in Nature susceptible of the *Magnetic Power*—Its Weight to that of Water is as *eight to one*, nearly—It dissolves in *Aqua Fortis* with a Rapidity and Effervescence beyond any other Metal—Is corroded by the Acid in the Air very readily, and becomes rusty—It is of a *whitish* glittering Colour, when broken—When red hot under the Hammer, it sends off *Scales or Flakes of calcined Iron*, highly *Magnetical*—It is never found Pure, but always in *Ore*, either *Pebble*, or a *hard Stone*—It may be extracted by the *Loadstone* from the Ashes of Plants—And yet discovers less of a *Vegetable Configuration* in *Crystallizing*, than any other Metal.

Euphros. And since *TIN* follows *Iron* in your Catalogue, so let me know next, what are its *Special Properties, Cleonicus*.

Cleon. There is nothing very Singular in *TIN*—It is, indeed, the *Lightest* of all Metals—Its Weight to that of Water is as little more than *seven to one*—In Colour it is as white as Silver—But it is softer than any other Metal but Lead—Is malleable to a considerable Degree—It melts with a small *Heat*—Very little Subject to *Rust*—Not at all *Sonorous*—It has the least *Fixity* in Fire of

any Metal—It intimately mixes with every other Metal, and makes them all brittle, but Iron—It is found in Ore of hard Stone, and also in opake Pebbles.

Euphros. The last of the *Solid Metals* you named was *Lead*, pray what are its Properties, *Cleonicus*?

Cleon. *LEAD* is *heaviest* of all Metals, except *Mercury* and *Gold*; it's Weight to that of Water being nearly as *eleven to one*—It is the *Softest* of all Metals—Therefore very *ductile* and *flexible*—It melts the soonest of any metal—The least *Sonorous* of all others—It has the least *Elasticity* of any Metal—And the *least fixed* in the Fire—It is seldom found pure, but in an Ore of a glossy Black Colour.

Euphros. The last Metal you said was *Mercury*, now that being a *Fluid Body*, and a Metal you defined to be a *Solid One*, pray, *Cleonicus*, what am I to do with this seeming Inconsistence?

Cleon. You have nothing to do, but to understand the Matter rightly, my *Euphrosyne*—*Fluidity* is one State of all Metals by a certain Degree of Heat; and *Fixity* or *Solidity* is another, by a Degree of *Cold* that our Air always affords; but that Degree is far from being sufficient to *fix Mercury*, or convert it into a *Solid Body*, nor yet is it cold enough at the *Arctic Circle*—But at *Petersburgh* an *Artificial Cold* has been made sufficient to fix it into a Body as hard as *Lead*, and whiter than *Tin* when cut—It was also *ductile* or *malleable* with the Hammer—and had all the other Properties common to Metals.

Euphros. I now understand you perfectly well, and can never expect to see it in this last State of *Fixity*—But, pray, *Cleonicus*, how happens it, that among all these *Metals*, you have not mentioned *BRASS*?

Cleon. Because it is not a *natural*, but only a *factitious Metal*, or made by Art; thus—to seven Pounds of pulverized *Ca'amine Stone*, they put five of *Copper*, and letting it stand in a Wind Furnace eleven Hours, it is in that time converted into *Brass*, as we commonly see it—*STEEL* is not properly a different Metal from *Iron*—It is only *Iron*, so altered by Art, as to become of a finer Grain, and harder in various Degrees; and so more fit for *Cutting Tools*—*PEWTER* is a Compound of several *Metals* and *Minerals*; as *Tin* mixed with *Lead*,
Brass,

Brass, Bismuth, &c.—*Tin Plates* are really *Iron Plates* tin'd over on both Sides, and are penetrated so strongly by the *Tin*, that they appear to be such by their Whiteness when cut—But still the Iron retains its Property of *Magnetic Virtue*, and is as much attracted when tin'd as before.

Euphros. Well, I think you must nearly have exhausted the Subject of Metals by this time *Cleonicus*; and pretty well spent yourself about it—Therefore I would excuse you from any further Trouble on this head, unless any thing extraordinary remains.

Cleon. There has been of late a Discovery made of a *New Mineral* called *PLATINA*, which has some Properties so remarkable, that I think my *Euphrosyne* should by no means be ignorant of—One of these is, that in it's Pure State, it is *heavier than Gold itself*.—According to the late celebrated *MUSSENBROEK*, it is heavier than Gold in Proportion of *twenty-seven to nineteen and a half*; consequently it is much the heaviest of all Bodies yet known.—It is also of a *Yellow Colour*, like Gold—But is hard and brittle—And with Gold and Silver, make very rich Compounds, superior to any *Bell-Metal*, *Pinchbeck*, or *Prince's-Metal*.—I have brought you a Piece of *Platina*, the best I can at present get, that my *Euphrosyne's Museum* may be wanting in no one Article that is curious.

THE
YOUNG GENTLEMAN AND LADY'S
PHILOSOPHY.

PART VI.
CONTAINING
The HYDROSTATIC MECHANIC PRINCIPLES *of*
PHILOSOPHY.

DIALOGUE I.

The Nature and Properties of WATER, OIL,
SPIRIT, and other FLUIDS; *explained and con-*
firmed by EXPERIMENTS.

Cleonicus.

WE have already largely treated of the Nature of Fluidity in general, and particularly the principal of all Elastic Fluids, the AIR, I shall now turn my *Euphrosyne's* Thoughts to the Contemplation of the Nature, Properties, Motions, and Effects of common and unelastic Fluids, such as Water, Oil, Spirit, &c. because the Knowledge of these will furnish her with the *Rationale* of many great and marvelous Effects, both of Nature and Art, which yet remain for her to be instructed in.

Euphros. The *Etiquete* of my Philosophical Studies I must leave to the superior Discretion of my dear *Cleonicus*.—My Part is that of a *Pupil*, and, at present, little more

more than a *Querist*—So in the first Place, please to inform me what *Fluidity* is, and what the Cause thereof?

Cleon. A Fluid is defined to be a *Substance whose Parts are free to move, and will be put into Motion by any the least Force impressed upon them.*—This you ever observe to be the Case of WATER, and all other proper Fluids.—But as to the *Cause of Fluidity*, you might as well ask me what is the Cause of Gravity? To which I could give no other Answer than, that it was the Effect of the Omnipotent *Fiat* of the Creator; who as he said, *Let there be LIGHT, and there was LIGHT*; so he said, *Let there be GRAVITY, and all Matter became heavy*—The same Almighty Being said at the beginning, *Let some Parts of Matter be fixed, and let others be Fluid*, and immediately, FIXITY and FLUIDITY in Matter were the Result—The *Fixed Parts* were called *Dry-Land*, or EARTH; the *Fluid Parts* he called WATER; and their gathering together into the immensely large and deep Cavities of the Earth, he called SEAS—This is all I think worth while to say upon such inscrutable and recondite Subjects.

Euphros. Well, *Cleonicus*, though we are not acquainted with the Causes of things, it is no Obstacle to our Knowledge of their most useful Properties and Effects, as is evident in the Case of Gravity—Please therefore to let me know what are the Principal Properties of Fluid Bodies in General.

Cleon. As the Particles of a Fluid are in their own Nature free to move, they will always be in a *Volatile State* by any *partial Force* that is impressed upon them; that is, they will be moved among themselves by the least force that is impressed upon their Surface, but this is not the Case of a fixed Body.

Euphros. This I know by common Experience, *Cleonicus*; and pray what is the next Property of Fluids?

Cleon. As the Particles of all *Fluids*, as well as *Solid Bodies*, are equally affected by the Attraction of Gravity, so they must be *equally heavy*—And hence it will follow, that Fluids press upon the Bottoms of Vessels which

contain them, with Forces always *proportioned to the Quantity of Matter*, and, of Course in *Proportion to their Height above them*.

Euphros. This I also very easily conceive; as a perpendicular Column of those Fluid Particles, standing upon a Point in the Bottom, must needs press upon it with all its Weight; and therefore with a Force answerable to the *Height thereof*—And what is said of one Column, is true of all, and therefore of the whole Body of Fluid, of course.

Cleon. You reason quite philosophically now, my *Euphrosyne*; but what will you say to the next Principle of Fluids, which is this, *that they exert a Force of Pressure, equal to their Gravity, every Way, or in all Directions equally?*

Euphros. Why all I can say to it at present, is, that I don't clearly understand such a Doctrine, *Cleonicus*—This I am sure of, that Solid Bodies press only in *one direction*, viz, *perpendicularly downward*—How Fluids press in *all Directions*, you will please to explain to me.

Cleon. I will, and that from one Observation only, which is their Universal *Equilibrium*, or that State in which they mutually equipoise and support each other, and thereby produce a *State of Rest* through every Part of the Fluid—Now as this is most evidently the Case of all perfect Fluids, it is certain that every Particle of the Fluid Mass must have a Force affecting it on every Side equally; since, were the Force greater on one Part than on another, it would produce Motion in that Particle, and destroy its *Equilibrium* or Rest.—And indeed it must be allowed as a self-evident AXIOM in *Philosophy*, *that a Body urged in every Direction equally, will be as perfectly at rest, as if it were affected by no Force at all*.

Euphros. Indeed you have placed this Matter in so Clear a Light, that it becomes a self-evident Truth, and admits of no other Demonstration.

Cleon. Another AXIOM, equally true, and almost as self-evident, must here be taken Notice of, as the Basis of all Hydrostatic Science, and indeed of all others, and that is, *that Action and Re-action are equal between any*
two

two Bodies, and in contrary Directions—The Reason of this is evident, when we only consider, that when one Body acts upon another, that Action is but *one and the same Thing* between both, and consequently must *equally* affect them—Thus if one Stone falls upon another, there is an Action, which we call *Collision* or *Striking* between both, but the Force of this Stroke equally affects each Stone.

Euphros. According to this Axiom, if we would speak philosophically, we should say, the *two Bodies strike each other mutually.*—

Cleon. That would be the true Stile of expressing this Case, my *Euphrosyne*;—And in regard to *Pressure*, it is evident, that *if you press a Stone with your Finger, your Finger is equally pressed by the Stone*, as appears by the Dent or Impression it makes in the Flesh—Again, if a Horse draw a Stone by a Cord, the Stone *re-acts*, and draws the Horse in a contrary direction as much.—For all the Force by which they act upon each other, is the *Tension of the Cord*, which is every where the same, at one End upon the Horse, at the other upon the Stone—If a Man in a Boat throws his Hook over a Post, and pulls it, the Post equally pulls the Boat, as appears by it's approaching towards it—Lastly, when the Oar strikes the Water one Way, the Water *re-acts*, and moves him in the other Direction.

Euphros. These Examples, with a little Habitude of thinking on such Subjects, will be sufficient to convince me of the great Truth you would inculcate, which, when applied to Fluids, I suppose is to prove, that with whatever Degree of Force they act upon the Particles in the Bottoms of Vessels that contain them, those Particles *re-act* with the same Force; and consequently sustain the Fluid in a *State of Rest*, in the same Manner as if there was no Force at all in either Fluid or Vessel.

Cleon. This being understood, you will easily be convinced of the Reason of many *paradoxical Phenomena* of Fluids, which would otherwise be quite unintelligible—But first it will be expedient you should see a Plain Proof of the equal Pressure of Fluids in every Direction—For this

Purpose, I have here brought a large tall Glass Jar of Water, into which various Glass Tubes you here see of different Sizes and Forms, will be immersed, to shew, that Water presses in all Directions equally.—

Euphros. I think *Cleonicus* is determined to make me understand Things whether I can or not.—

Cleon. I am too well convinced of your Ability for understanding Things much more difficult than these.— As to the present Experiments, they give you *Ocular Demonstration*, my *Euphrosyne*—and what can you wish for, easier or more convincing?

Euphros. Nothing, certainly.—*Seeing is Beliving*, we use to say, but I think it is more, it ascertains the Fact—therefore proceed, *Cleonicus*.

Cleon. I have no need to prove that Fluids *press downwards*, that you know is the natural Result of their Weight—That they *press upwards*, is shewn by immersing this *Strait Tube* open at both Ends now, into the Water, with one End closed by my Finger—As now you see it, at six Inches depth—and what is the Consequence, *Euphrosyne*?

Euphros. I see nothing but a little Water enter the lower End of the Tube, *Cleonicus*—

Cleon. Well, now observe what follows, when I take off my Finger—look now—

Euphros. I that Instant saw the Water jump up in the Tube, to the Surface of that in the Jar.

Cleon. Well, then here is a *double Proof of the Pressure of the Fluid upwards*—For first, while the Tube is close, you observed the Water by pressing against the Air in the Tube drove it upwards, and condensed it, till the Spring of the Air downwards was equal to the Pressure of the Water upwards; and then an *Equilibrium* followed.—But, secondly, when I took off my Finger, the Air escaped, and the Water was forced up into the Tube to the Height of the common Surface, where again an *Equilibrium* ensues.

Euphros. This process is so plain in each Part, that it is a compleat *double Proof of the Pressure of the Fluid upwards*.—Then, *Cleonicus*, how do you prove the *Pressure Side-ways*?

Cleon.

Cleon. By another Tube bent to a right Angle at one End, so that when it is held upright, that lower Part is in an *horizontal Position*.—Therefore when this is placed in the Water, as the other was, the same Effects will be produced as you saw in that.—But here the Water enters the Tube *Side-ways*, or in an *Horizontal Direction*.—Therefore the Pressure *Side-ways* is, in every Respect, equal to that in the Perpendicular *upwards and downwards*.

Euphros. Nothing can be more evident, and doubly so.—

Cleon. Then here you have two other Tubes, with their lower Ends turned obliquely *above and below the Horizontal Line*.—Therefore when these are placed in the Water, it must enter them in an *Oblique Direction*.—And this you see by Experiment it does, in all other respects, the same as before.

Euphros. You have made this Truth of the *Water's Pressure in every Direction equally*, so very visibly intelligible, that I dare say the dullest Hero of the *Dunciad* could not help understanding it, had he seen these Experiments.—And now what comes next, *Cleonicus*?

Cleon. The Consideration that this Pressure of Fluids is variable with its *Height only*, and has no Dependence on the Form of Tubes, the Vessels which contain the Fluid, nor the Quantity of the Fluid into which they are immersed.

Euphros. And can you illustrate all this as easily by Experiment?

Cleon. I can.—You here see a Tube of a very irregular Form, crooked throughout; bigger in one Part than in another, and in some Parts round, and in others flat.—And yet by immersing it in the Fluid, with the upper End close and open, as before, the same Effect is produced, that is, the *Fluid rises to the same height within as without*.—Again, if any of these Tubes be immersed in your *Quart Decanter of Water*, where it is large in Bulk at the Bottom, and small at the Top, you see every Appearance the same as before.

Euphros.

Euphros. I have not now a doubt of the Truth of this fundamental Proposition, *that Fluids press in every Direction with a Force proportioned to their Height.*—And what am I to learn next, *Cleonicus*?

Cleon. That when two Columns of the same Fluid communicate with each other, *they mutually sustain each other to the same Height.*—This you see proved by an Experiment of the *incurved Tube*; for when I pour Water into one Part, it naturally runs into, and rises up in the other, *so as to stand at equal Heights in each, above the Horizontal Line*, and that in every Position of the Tube, upright, or inclined.

Euphros. I see the Thing you mean, most convincingly plain.—I also have a more explicit Idea of what you call the *Height of the Fluid*; for this, I find, is its Height, in every Case, above the *Horizontal Level.*—I make no doubt but something considerable depends upon these very peculiar, and extraordinary Properties of Fluids, *Cleonicus*.

Cleon. You may very well think so, my *Euphrosyne*; perhaps there is not a System of Principles fraught with more interesting and useful Inventions, Arts, and Machines, than those of *HYDROSTATICS*, in all the most important and necessary Articles of Life.—Indeed we all know this by daily Experience, and feel the universal Blessings of this Science in every Department of Life.—The very Names of *Hydrostatic* and *Hydraulic* Instruments, such as *Aqueducts*, *Water-Levels*, *Hydrometers*, *Hydrostatic Ballance*, *Fet d'Eaus*, *Pumps*, *Mills*, &c. are sufficient to indicate their absolute Necessity to the very Existence of a State or Community.—Of these Subjects, therefore, we shall proceed to treat in our future Conversations, and I make no Question how much soever they may be, as to their *Rationale*, neglected and despised by some, they will afford the most agreeable Information and Amusement to all Young Ladies of my *Euphrosyne's* good Sense and Understanding.

DIALOGUE II.

*Of the Origin of SPRINGS, RIVERS, and LAKES.
Of Medicinal and Hot BATHS. The Use of the
SIPHON, and Tantalus CUP. Of Perennial, In-
termitting and Reciprocal SPRINGS.*

Euphrosyne.

AT our last Meeting, *Cleonicus* was pleased to compliment me with a Supposition that after premising the Properties of Fluids, I should find but little or no difficulty in understanding the general Reason of the most important and necessary Instruments and Phænomena which depend upon, and result from them.—Therefore I am now prepared, with great Attention, to hear you descant on such useful Subjects.

Cleon. The first Thing I shall observe to my *Euphrosyne*, is, that from these Properties of Fluids it follows, that the Surface of every Fluid must necessarily be a perfect PLANE or LEVEL, if large, and left entirely to itself.—For every Column of Fluid Particles, gravitating towards the Center of the Earth, must be all at an equal Distance from it, and of Course the Surface of the whole must be equidistant likewise; and therefore parallel to the Horizon, or a true Level.

Euphros. This Point I conceive very clearly.—But will it not follow then, *Cleonicus*, that if our Earth were a perfect Globe, the Water, upon it, wherever sound, being at an equal Distance from the Center, would become Motionless or *stagnant*, and so quite useless to Mankind? I ask this, because I have heard some great Philosophers suppose the Earth before the Flood, had that Figure.

Cleon. Indeed, my *Euphrosyne*, you mistake; they could be no great Philosophers who have amused Mankind with wild and whimsical Conceits.—There could be no Possibility of Rivers at all in such a *spherical Earth*; for Rivers are only Waters descending by their Gravity from higher to lower Parts of the Surface, in proper Channels; but in

a *globular Surface*, there is no such thing as *high and low* Parts to admit of any such Descent.—Therefore as *Rivers*, and moving Waters, are necessary for Mankind in their present State, there is no doubt but they were always so, as well before the Deluge as after.—But leaving such idle Reveries, let us advert to the *true Cause* of Rivers, Springs, &c. which we shall find entirely owing to great Quantities of Water collected on the Tops and Sides of *high Lands* and *Mountains*, from *Rain*, *Snow*, *Fogs*, *Dews*, and even *Clouds* themselves, and running through various Chinks and Crannies into their internal Cavities and Basons, and filling them full.—After this the superfluous Water flows from those Cisterns through different Crevices, to the Sides of the Mountain where they appear as *bubbling Springs*, and stand in hollow Places in Form of *Pools*, *Ponds*, and *Lakes*, as we every where see.

Euphros. This seems to be a very natural Account of the Origin of *Rivers*, *Springs*, and *Lakes*, and I suppose, of *Baths* too, for they are only standing Pools, for the use of *Bathing*.—But pray *Cleonicus* whence do those Bath-Waters derive their *Medicinal and healing Qualities*? and what is still more strange, that Degree of *Heat* that we find in many of them?

Cleonicus. These are Questions I might naturally expect my *Euphrosyne* should ask.—To the *first* I answer, that the Mountainous Parts of the Earth are only very high and large Rocks, covered with Verdure and Herbage on the Outside, and abounding with all Kinds of Mineral Matters within, at least this is generally the Case.—Now the Earth is the *Elaboratory* of an Omnipotent CHYMIST, who can create, compound, and analyse all kind of Bodies, so as to give them such various Specific Qualities as are necessary for the Cure of Diseases, Animals are subject to.—The internal Parts of the Earth do also abound with numberless unseen Caverns, Cisterns, Streams and Rivers of Water, which run every Way through *Beds* and *Strata* of *Mineral*, *Metallic*, *Sulphureous*, *Saline*, *Mercurial*, *Bituminous*, and *Oleaginous Substances*, it is no wonder they should absorb and carry with them all the Soluble Parts of those Bodies; and wherever they rise in the Form of Springs, they should be found possessed

fessed of Variety of Medical Qualities, some of one Sort, and some of another.

Euphros. Well, this is a pleasing Idea you give me of Medical and Mineral Springs, Baths, &c. because it is undoubtedly the natural and true one.—But now, *Cleonicus*, you will satisfy my second Query, why they are very often hot to a surprising Degree?

Cleon. My *Euphrosyne* need not be told, that the horrible Volcanos of *ÆTNA* in *Sicily*, *Vesuvius* in *Italy*, that of Mount *Hecla* in *Iceland*, besides *Strombolo* Island, and many others, all demonstrate the inconceivable Quantity and Force of *internal Fire* in the Earth.—That the *Lava*, which runs in red hot Streams from the Mouths of these fiery Furnaces for Miles together over the adjacent miserable Countries, is all the Effect of the great and wonderful Powers and Operations of *natural Chymistry* in the interior Parts of the Earth.—That *Solfatara*, and other Parts of the Earth's Surface, *breath Fire and Smoke* continually.—That, therefore, it is no wonder if Streams of Subterraneous Running Waters, passing by those ignited or heated Parts of the Earth, should be heated by them in various Degrees, and so produce all Varieties of Warm and Hot Baths; as those at *BRISTOL*, *BATH*, and all the World over besides.

Euphros. Well, I am infinitely obliged to you for such satisfactory Intelligence.—And I think, *Cleonicus*, we may account for Waters coming into WELLS, from these under-ground Currents also, may we not?

Cleon. You not only may, but you must, my *Euphrosyne*, as there is no other Way for our Wells to be filled.—All the superficial Parts, near the Earth's Surface, are replete with Canals and Currents of Water both great and small, and in some Sort resemble the Circulation of Fluids in an Animal Body; insomuch that some eminent Philosophers have been ready to conclude that this Earth we live on, is itself only a huge Animal.

Euphros. For Heaven's sake don't talk of that, *Cleonicus*.—I shall look upon myself only as a Louse crawling upon a large Animal, if you do.—

Cleon. Let not *Chimæras* derange my *Euphrosyne*.—Things of more Consequence demand your Attention.—

Besides

Besides *Hot and Cold SPRINGS*, there are other Distinctions well worth the *Connoisseur's* Notice.—Thus some are called *Perennial Springs*—others, *Intermitting Springs*, and lastly, there are a wonderful Sort called *Reciprocating Springs*.

Euphros. I shall be glad to be particularly informed of these; and in the first Place, what are those called the *Perennial Springs*, *Cleonicus*?

Cleon. They are such as flow constantly, from *Year to Year*, without Cessation.—These are found in the Sides of all high Mountains, and in the Valies and low Lands between—These Mountainous Ridges supply plenty of Water to all the Springs and Lakes they feed, witness the *Lake of Geneva* among the *Alps*; ——— and indeed all our common *Springs*, *Fountains* and *Fish Ponds* are of this Sort.

Euphros. I understand you perfectly well as to these.—But for those *Fountains* you call *Intermitting Ones*, I apprehend you mean such as do not always flow, but stop sometimes, and afterwards flow again—am I right, *Cleonicus*?

Cleon. You will be quite so, if you consider those *Intermissions* or *Alternations* as *regular and constant*, that is, that they flow and stop, by equal Intervals of Time, and such are here and there to be found.—But to account for this singular Phænomenon of Springs, it is necessary you should first be acquainted with the Nature and Operation of the common *SIPHON* or *SYRINGE*, which, you know, is only an incurved or bent Tube, with one Leg shorter than the other.—Now if this Siphon be inverted and filled with Water throughout (having first stopped the Orifice of the shorter Leg with the Finger) then sloping the Orifice of the longer Leg with a Finger of the other Hand, the Tube may be easily turned with the Curve upwards, and the shorter Leg immersed in a Jar of Water, then removing both the Fingers from the Ends of the Siphon, the Water will necessarily descend in the longer Leg, and run out,——And this it will continue to do till the Water in the Jar descends to the Orifice of the shorter Leg, when the Operation must be at an End.—And all this, you see, I demonstrate by an Experiment of a *Siphon in Glass*.

Euphros.

Euphros. The Operation of the Siphon is very plain, and is a most curious Effect.—But the Reason of it, though I plainly see it, *Cleonicus* can make perspicuous in a more satisfactory Degree.

Cleon. The *Rationale* of the Action of the Siphon consists in three Particulars, (1.) The *equal Pressure of Air* upon the Fluid at each End of the Siphon. (2.) The *unequal Weight of the Fluid* in each Leg. (3.) The *continuity of the Fluid*, or its being kept together, while in the Tube, by the Pressure of the Air at each End.—Therefore it is evident, when the shorter Leg is put into the Fluid, and the Finger removed from the End of the longer Leg, the Water in that, by its greater Weight, will descend, and keep running out, till all of it be exhausted from the Vessel.

Euphros. I could not wish to see any thing more evidently.—Now I suppose I am qualified to comprehend what you have to say further of *intermitting Springs*, *Cleonicus*.

Cleon. You certainly are, my *Euphrosyne*.—But as the Origin of Springs and Fountains lie out of Sight, we cannot too much Elucidate a Matter of so great Consequence, therefore another Invention, usually called the *TANTALUS CUP*, has been applied for this Purpose.—This Cup is of the Form of a Common *Quart Pot*, as you here see;—it has a handle, as in that; but this Handle is not solid, but hollow throughout.—It is on one Part inserted into the Side of the Cup at the Bottom, and rises on the Outside, nearly to the Top, where it turns down, and reaches to a little below the Bottom of the Cup.—You will then easily perceive this Handle is a real Siphon,—and that when Water is poured into the Cup, it rises in the Handle at the same time equally, till the Water in the Cup is as high as the curved Part of the Handle.—And continuing to pour in Water, it will run over the Curve, and descend in the outer Part of the Handle to the Orifice, where it will run out, and so continue running, till all the Water in the Cup is by that Means carried off.

Euphros. The Glass Cup and Handle, makes every thing so intelligible, that there is no room left to ask any further

further Questions about the Siphon.—But now, *Cleonicus*, please to let me see how you adapt this Experiment to explain the Nature of *Intermitting and Reciprocating Springs*.

Cleon. I will endeavour to do it, my *Euphrosyne*;—The Body of the Cup presents to you the Idea of some large Reservoir or Bason of Water in the interior Parts of the Mountain supplied by feeding-Streams, or Ducts, from all the circumjacent Parts.—The *Handle* of the Cup represents the Duct or Canal, by which the Water is conveyed from the Reservoir to the Side of the Hill.—Here it is necessary to consider this Duct as coming from the Bottom of the Reservoir, and gradually rising in its Progress to a Height a little less than the Level of the Water in the Bason, where taking a Turn, it descends to a Part in the Side of the Mountain below the Level of the Bottom of the Bason;—and there it will break out in Form of a *Spring*, supplying a Pool or Fountain with Water, till it has drained off all that is in the Reservoir, and then the Spring will cease, or intermit, till the Bason is filled again, when the Siphonic Duct will again begin to work and bring a fresh Supply to the Fountain.

Euphros. I see now how such a Fountain must naturally intermit its Action.—That the Water must flow while the Subterraneous Siphon works; and cease, while the Reservoir is recruiting.—That if the Time taken to refill it be considerable, the Pool on the Hill may become dry, and then be filled again, and so on constantly.—

Cleon. Indeed my *Euphrosyne*, you are happy in your Apprehension of Things.—The Case of *Reciprocating Springs* will give you no trouble.—For it only supposing this Siphon, instead of going to the Side of the Hill, should find another Reservoir in its Way, in a Situation lower than that from which it comes, and which supplies a common constant Spring, then will it discharge all the Water from its own Bason into this, and of course, raise the Surface of it very sensibly; which, when the Operation of the Siphon ceases, will again subside to its common Level.—Thus a *Tide of Flood and Ebb* will alternately succeed

success each other, as regularly as you observe it in the River Thames.

Euphras. Well, you have thoroughly satisfied my inquisitive Curiosity in regard to *reciprocating Springs*.—But after all, *Cleonis*, do you really know that such curious *Phænomena* do any where exist?

Cleon. I have not only read of many, but am an Eye Witness of one that is without Doubt the most extraordinary in *Britain*, if not in the World.—It is near *Brixham*, a Fishing Town in *Devonshire*, by *Torbay*; the Name of it is *Lay-well*.—The Water of this Spring is enclosed in a Sort of Stone Well above Ground, of nearly a round Form.—This Fount feeds a large Stream, about five Feet wide, with a Sandy Bottom, bestrewed with large and small Pebbles.—When I observed it, the Time it took to ebb and flow was very uniform and regular.—Both together took up Six Minutes, so that it ebbed and flowed ten Times in an Hour.—The difference between *high and low Water Mark* in the Fountain, was an Inch and Half.—And the very Stream it supplied, also ebbed and flowed about Half an Inch, as was seen by the Sides of the large Pebbles, which were never dry.—I caused Holes to be dug in the Earth, in Parts at a Distance from the Well, about a Foot deep, and it was as surprising as pleasant, to observe the Water rise bubbling up into those Holes, by many small Passages.—The Holes were filled and emptied by turns.—The Water at ebbing gradually subsided, and I could see it run down into the Earth by a Number of little Ducts or Holes at the Bottom.—There were High Grounds or Ridges of Land on one Side, which filled the Declivities every where with these reciprocating Springs.—The Water is exceeding fine and soft, and much used by the Villagers at *Lay-well*.—Perhaps the Reciprocations of this Spring are the quickest of any yet known—Nor can there be a more conspicuous View of the *Origin of Rivers*, generated by the Union of many such Streams and Rivulets, as that here produced.

Euphras. The whole of this Relation gives me unparalleled Pleasure.—I am hereby led into a Species of Knowledge which I never at all expected.—This Si-

phon, or rather this *Tantalus Cup*, is an admirable Illustration of these recondite Parts of Philosophy.—I shall beg this Cup and Siphon of *Cleonicus*, for my Recreation in Experiments of this Kind at leisure Intervals.

Cleon. They will find you in many pleasing Amusements.—You may with the Siphon (or *Crane* as is vulgarly called) decant off a Bottle of *Wine* or fine Ale, without disturbing the Sediment at Bottom.—You may place one of your little *China Images* in the Cup, and pour Water in, which when it rises to his Lips, will subside, being carried off by the Handle.—Indeed this curious Experiment gives Name to the Cup, as it is an apt Representation of the Fable of TANTALUS, condemned to eternal Hunger and Thirst, as finely described in POPE's HOMER in the subsequent Lines.

*There Tantalus, along the Stygian Bounds,
Pours out deep Groans ! (with Groans all Hell abounds)
E'en in the circling Floods Refreshment craves,
And pines with Thirst amidst a Sea of Waves ;
And when the Water to his Lip applies,
Back from his Lip the treach'rous Water flies,
Above, beneath, around his hapless Head,
Trees of all kinds delicious Fruitage spread ;
There Figs, high dy'd, a Purple Hue disclose,
Green looks the Olive, the Pomegranate glows ;
There dangling Pears exalted Scents unfold,
And Yellow Apples ripen into Gold :
The Fruit he strives to seize, but Blasts arise,
Toss it on high, and whirl it to the Skies.*

DIALOGUE

DIALOGUE III.

Of the Uses of the Water and Spirit Level, in the ART of LEVELING, and conducting RIVERS and CANALS for Inland NAVIGATION. Of RESERVOIRS, AQUADUCTS, and PIPES of CONDUIT.

Cleonicus.

I am happy to find my *Euphrasyné* was so well pleased with our last Speculations on Springs and Rivers—But we have not yet done with the Doctrine of *Running Water*—I believe my *Euphrasyné* will think *Hydrostatics* are not a dry Part of *Philosophy*, e're we have done.

Euphros. I am sure those who do think so, are very much mistaken.—If I receive but half the Encrease of Knowledge to Day, as I did from your Lecture Yesterday, I shall think my time extremely well spent—And pray, *Cleonicus*, what do you proceed upon now?

Cleon. The application of the peculiar Properties of Fluids to the Invention of several very useful and necessary Instruments and Machines in common Life, which principally distinguish Scientific and civilized People from Barbarous Nations.—Among these I think the *LEVEL* the most simple, and a ~~very~~ useful Instrument.—There are two Sorts of them, one is a *Water Level*, and the other a *Spirit Level*.—One of each I have here brought, that you may see their Construction and be better acquainted with their Use.

Euphros. I am much obliged to you, *Cleonicus*—I shall attend to what you say of them, very earnestly.

Cleon. The *Water Level* is, you see, only a long Glass Tube turned up at each End, to a right Angle, or nearly so; you know that if the Water be poured in to fill the Tube, and a part of each upright Leg, then the Surfaces of the Water in each of these Legs will be in a *Horizontal Line*, and thereby prove a very fit Instru-

ment in the ART OF LEVELLING, or finding how much any Part of the Earth's Surface is above or below the true Horizontal Level of the Place where you are.

Euphras. Pray, *Cleonicus*, could you illustrate this by Experiment?

Cleon. Very easily, my *Euphrasine*—You see I place the Level upon this three Leged Stand, just the Height of your Eye,—I then turn it about the Center till it is directed to the Side of yonder distant Mountain.—I now fill it with Water to half the Height of the Legs, and both the Surfaces settle themselves in *Equilibrio*, and in a true Level, of Course—Now apply your Eye about, a foot from the Level. so as to see the Surfaces of Water coincide or be in the *Visual Ray* or *Level*.

Euphras. This I find is very easy to do——But what, then *Cleonicus*?

Cleon. Then observe what you see upon the Side of the Hill that is in the same Visual Line, and that is all you have to do.——

Euphras. This I shall do——I see on the Side of the rising Hill, a Tree just in the Visual Line that passes through the Surfaces of Water——

Cleon. Well now you find that as that Tree is in the *Horizontal Level* of this Place, you need not be told, that if a Canal was made by Art from hence to that Tree, and there to communicate with a Spring of Water, not any of that Water would flow to us; for as it had only a Horizontal Plane to move upon, it could not possible move at all.—But if the Spring or Fountain was any thing higher than that Tree upon the Hill, it is as evident the Water would flow through or down such a Canal to this Place——

Euphras. I see now the Purport of your *Level* is to shew when Water can be brought or carried from one Place to another, which to be sure is of prodigious Service to Mankind.—But pray, *Cleonicus*, how much must this Canal rise or fall in its Course above or below the Horizontal Level, that the Water may move therein neither *too fast* nor *too slow*, for the common Uses of Life.

Cleon.

Cleon. At the Distance of *one Mile*, the Canal should, at least, descend 12 or 15 Inches below the Visual Line, for the Water to run with a proper Velocity.—Such, for Instance, as that in the *NEW RIVER* brought from *Ware in Hertfordshire to the Reservoir at Islington*—Also in those *Inland Navigations*, in many Parts of England, to the vast Emolument of the Public.

Euphros. Well I think, *Cleonicus*, I have made a great Proficiency in the Philosophy of *Springs, Fountains, Rivers, &c.* for you have made all so plain by Experiments, that I am ashamed to think of troubling you any further about them.—But I remember you mentioned another Sort of *Level*, which you intimated, was made with *Spirit*, pray what one is that *Cleonicus*?

Cleon. This is a small portable Level, consisting of a Glass Tube filled with Spirit and a small Bubble of Air, and hermetically closed at the End.—The Size of it is from 2 to 12 Inches long, and from four to $\frac{1}{2}$ an Inch diameter, more or less, as occasion requires.—It is generally included in a Brass Tube, with a long Aperture on the upper Part, to shew the Motion of the Bubble of Air through the Body of Spirit—The Fluid is *Spirit*, as being more free to move than *Water*.—One of Six Inches length I have brought to shew my *Euphrosyne*.

Euphros. And a curious little Instrument it seems to be—It is pleasant to observe how nimbly the *Air Bubble* runs one Way and the other—I try to keep it steady and without Motion, but I cannot for the Life of me—Pray how is it used *Cleonicus*?

Cleon. Its Use results from that *extreme Mobility of the Air-Bubble* you observed—For the Spirit being a Fluid so much heavier than Air, will always possess the lower part of the Tube, and the very light Air of Course, will therefore be driven to the upper or higher End—It can, therefore, never happen that the Air-Bubble should be seen at rest in the Middle of the Tube, but when it is placed on a *perfectly level Plane*, for there only all Fluids can be at rest.

Euphros. You have given the Reason explaining the Nature of the Level so clearly, that I shall trouble you no further, but that I have a little Curiosity to know how such a ticklish Thing as this is applied to answer any

great Ends in Life——Can you shew me that by Experiment, *Cleonicus*?

Cleon. I flatter myself, I can do it to my *Euphrosyne*'s Satisfaction.—For this Purpose I have before-hand provided this plain round Board of Mahogany, with three Screws at an equal Distance——Upon this Board I place the *Spirit Level*; and the Bubble you see, immediately runs up to one End, because the Board is not yet level.—But as it is an Inch above the Table, I turn the Screw (or Screws) backward next the Bubble till the Board sinks low enough to bring it in View, but then it runs up to the other End.—This shews I had turned the Screws to much backward, therefore I gently turn one or both a little forward, and the Bubble slowly returns, and rests almost in the Middle.—The smallest touch of the Screws will now bring it quite to rest in the Middle.

Euphros. I see a little Time and Patience is required for this Operation, *Cleonicus*.

Cleon. And what can be done without, my *Euphrosyne*? while the thoughtless *Angler* grudges no Time nor Patience in his cruel Sport, the generous Sons of Science should not think much of any Trouble they meet with in adjusting their Instruments for Public Use. But the Business is as yet but half done; for the Level must be put into a direction at right Angles to that which it now has; and if the Bubble then continues in the middle, the Board is in a true Horizontal Plane.—I try the Experiment, and find it does not.—But as it is but little out, it wants only a small Adjustment by the Screws, to bring it nicely to the middle Point.—And this you see me do, and the whole Operation is over.

Euphros. I perceive, at Length, that the *whole Use of this Spirit Level*, is to make any other Plain Surface a *true Level*, or *Horizontal Plane*, to answer some special Purposes.

Cleon. That is the whole Affair, my *Euphrosyne*, and it is important enough too.—As this Spirit Level is very concise, portable, and soon adjusted for Use, it is preferred to the Water-Level by Artists in all their Occasions for a *Level*.—From what I have said, it appears, that it is the *sole Instrument* used in the extensive *Art of Levelling*.—It is also the Foundation of the still more general *Art of SURVEYING* or *Measuring Land*; for by this the *Theodolite* is first to be truly adjusted to a Horizontal

zontal Level, before the Surveyor can use it.—In all *Horizontal* DIALS, the Level is absolutely necessary; for no such Dial can shew *true Time*, that is not placed upon a *levelled Plane*.—In the *Art of GUNNERY*, no Piece of Ordnance can be elevated to the necessary Angle for striking a distant Object, but by the Assistance of the Level.—Besides many other Cases wherein the use of the Level is indispensable.

Euphros. How great is the Use of many things we little think about! I scarce knew of the Existence, much less of the momentous Value of this small Implement of Art.—We have now about a Quarter of an Hour to spare, pray what is to employ that, *Cleonicus*?

Cleon. The Consideration of *AQUEDUCTS*, my *Euphrosyne*.—An *Aqueduct* is any Conveyance of Water by Pipes, Canals, or otherways, from one Place to another; but what I chiefly intend here, is that by Pipes of an incurvated Form, and by which the Water is carried from a Reservoir or Fountain-Head, to any Distance below it, whether it be in the Vale below, or on the Side of a rising Hill beyond.—And the general Reason of this, my *Euphrosyne* by this time knows very well.—However, I have thought proper to fit up an Instrument for a more immediate and adequate Representation of the Aqueduct I mean.—This you see consists of a Brass Cylindric Cup on the Top, about four Inches over, and three deep.—Into this is cemented a Glass Tube, about twelve Inches in length.—This upon the lower End, you see, has a little Brass hollow Joint affixed;—and upon this is put another Glass Tube, bent, as you see, into a *Serpentine* Form, and moveable into every Position.—In all this, great Care is taken that every Part is perfectly *Water-tight*.

Euphros. I see at once the Intent of this Machine, or else I am much mistaken.

Cleon. I dare say you are too quick sighted to be mistaken at all, my *Euphrosyne*.—You see the Brass Cylinder on the Top is the Reservoir or Fountain in some high Situation;—the Glass Tube connected with it, is the *Conduit-Pipe*, that conveys the Water to any lower Part.—That the *Serpentine* Tube being placed perpendicularly, shews

how the Water may be carried *over the Vale*, and up to any Part of a *rising Hill*.—And from that Hill over the Vale to the Top of another, if there were Occasion, and so on,—Lastly, you see, when I place this crooked Tube in a *Horizontal Position*, it shows how the Water may be carried *round about the Hill* without laying Pipes over it. —

Euphras. Well, this Piece of Mechanism is an admirable Elucidation of the *Nature of an Aqueduct*.—But pray *Cleonicus*, since it appears to be so easy to conduct Water through Pipes to any Place, however situate, or however distant, whence comes it to pass that the *Ancients* are so much celebrated for their prodigious Works in Architecture of that kind—I think they are as famous in History for their *Aqueducts* as for their *Amphitheatres*.

Cleon. This Question, I own, I find not very easy to answer.—The *Romans* knew full well the Use of Pipes for such Purposes.—Nay *Ovid*, who lived in *AUGUSTUS's* Reign, expressly mentions *Conduit Pipes of Lead*, in his Story of *Pyramus* and *Thisbe* (*Metam.* Book 4.)—Also a Circumstance of a broken Pipe ejecting Water with great Force, by way of Simile, to the Blood gushing out of the Wound of *Pyramus* when he had stabbed himself.—As this has some Relation to a Subject we shall treat of at our next Meeting, to rehearse it here, will serve for a Conclusion to this.

*Then in his Breast his shining Sword he drown'd,
And fell supine, extended on the Ground;
As out again the Blade he dying drew,
Out spun the Blood, and streaming upwards flew.
So if a Conduit-Pipe e're burst you saw,
Swift springs the gushing Waters through the Flaw:
Then spouting in a Bow, they rise on high,
And a new Fountain plays amid the Sky.*

DIALOGUE

DIALOGUE IV.

Of the PRESSURE of FLUIDS, in all DIRECTIONS equally. Of the CENTER of lateral PRESSURE by Experiment. Of the Hydrostatic PARADOX, demonstrated by a proper INSTRUMENT for that PURPOSE. Of JET D'EAU, or FOUNTAINS.

Euphrosyne.

I Think myself very happy, *Cleonicus*, to meet you again on an Affair of so honourable and interesting a Nature, as an Explication of the Nature of Bodies in general, but now of *Fluids* in particular.

Cleon. At present our Reflections will turn upon the Action of Fluids upon solid Bodies, or Vessels which contain them, arising from their Weight and Pressure, the Means by which such Forces may be estimated, and the wonderful Effects that are thereby produced.—As to the first of these, viz. The Pressure of Fluids being every way proportioned to their Height only, we have discoursed so largely already, that there is only one thing more to add, and that perhaps you may think a little surprising.—

Euphros. I shall listen to hear what that is, as every thing striking delights me greatly.

Cleon. It is this, my *Euphrosyne*; the Pressure of the whole Ocean against a Pen, Dam, or Sluice, is not a tittle more than that of the least Quantity of Water conceivable standing against it to the same Height.—

Euphros. Why this sounds very strange, indeed, at first Hearing.—But I pride myself so much with the Proficiency I have already made in Hydrostatics under my dear *Cleonicus's* Tuition, that I am vain enough to think I see the Reason of that Paradox;—for if Height only be the Measure of the Force of Pressure in Fluids, then their Quantity can avail nothing, though equal to the Ocean.

Cleon. Well, I see you make no difficulty of this first Paradox,

Paradox, but before I pose you with any more, I shall explain to you the Means by which you may estimate the true Force of Pressure against the Side of any *Pen, Sluice, or Vessel* in which it is contained.—And then, how it may be expressed in Pounds, Ounces, Drams, &c. of *Averdupoise* Weight.

Euphros. All this I should like to know very well, if you think me competent to it, *Cleonicus*.—

Cleon. I think you as equally competent to that, as you are to cast up your Mantua-Maker's Bill.—Since all you have to do, is only to cast up a small Number of Figures into one Sum.—The Reason of this my *Euphrosyne* will perceive, when she considers, that as the fluid Particles are equal among themselves, so their Weight or Pressure upon one another in a perpendicular Line, must equally increase in proportion to their Number.—Thus, upon the Surface of the *first* Particle, there is no Pressure.—Upon the Surface of the *second* Particle this Pressure is as 1.—Upon the Surface of the third, it is as 2.—Upon the fourth Particle, it is as 3.—And so on, to the tenth Particle, where the Pressure is as 9.—Then the Pressure upon each of the ten first Particles will be represented by this Series of Numbers, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.—You understand me thus far, I dare say.

Euphros. Without the least Difficulty, *Cleonicus*, the reason of the Thing speaks for itself.

Cleon. Then you have only one Thing further to consider, and that is, *that in any Series of Numbers which proceed by equal Differences, the Sum of the whole Series is always equal to the greatest Term or Number, multiplied by half the Number of Terms*.—Thus in the present Series 0, 1, 2, 3, &c. there are ten Terms, differing by 1.—Then if the last or greatest Term 9, be multiplied by 5, (half the Number of Terms,) the Product will be 45.—This you will find to be the Sum of all the Terms, or of the nine Digits, if you reckon them up.

Euphros. I will, though I never did before.—They sure enough amount to 45.

Cleon. Then since the Pressures of the Fluid Particles against the Side of a Vessel in a Perpendicular Line, are expressed

expressed by those Numbers, the Sum of all the Pressures taken together, will be as the greatest Pressure at Bottom (which is as the *Depth* of the Vessel) multiplied by half the Number of Pressures (which is half the Depth)—That is the Pressure upon a perpendicular Line in the Side of the Vessel is *but half what it is upon the same Line at the Bottom of the Fluid.*

Euphros. I see the Proof of the Proposition in general; but you will give me time to make up my Thoughts a little more precisely about it, at my leisure, *Cleonicus.*

Cleon. I don't expect you should be an *Adept in Hydrostatics* all at once.—Though I believe, when my *Euphrosyne* considers the Vessel which holds the Fluid may be of a *Cubic Form*, and as the Pressure upon the Side is equally encreasing, and that upon the Bottom every where the same, she will easily perceive from what has been shewn, that the Pressure upon the Side is equal to *half that* upon the Bottom.—And since there are four of these Sides, there will be *twice the Pressure* upon all the Sides as there is upon the Bottom.—And consequently the whole Pressure upon all the Surface of such a *Cubic Vessel*, will be equal to *three times the Weight of the Water which fills it.*

Euphros. Then I apprehend, since you know the Weight of any Quantity of Water, you can tell very easily what the Pressure thereof will amount to in *Pounds, Ounces, &c.* against any given Surface.

Cleon. With the utmost Ease, my *Euphrosyne*; and so will you too, when you are informed, that the *Weight of a Cubic Foot of Water is almost exactly, 1000 Ounces, or 62½ Pounds.*—Hence it will follow, that if a Pen or Dam be 20 Feet long, and the Water rises against it to the Height of 12 Feet, then there will be 240 square Feet of Water against the Pen.—This multiplied by 6 (half the Depth of the Water) will give 1440 Cubic Feet of Pressure.—The *Pressure* therefore, against the Side of the Wall or Pen, is 1440 times 1000 Ounces, or 90,000 *Pounds.*

Euphros. It is well I happened to learn Arithmetic far enough to comprehend such a Computation, or else all this Affair, curious as it is, had been lost upon me.—

Indeed,

Indeed, *Cleonicus*, I believe very few of my Sex, besides myself, know how many *Pound Weight of lateral Pressure* there is in a *Pail of Water*.——

Clean. Not of my Sex neither, if you go to that.—— But there is one thing further that I could wish to give my *Euphrosyne* some Idea of; and that is, the *Center of Pressure* in Fluids.——The Weight of the Fluid you know upon the Bottom and Side, but in what parts of the Side the *whole Force of Pressure is united*. I believe you must be content, at present, to learn from an Experiment.

Euphros. I shall be content, and very thankful too, to learn every thing my *Cleonicus* shall think a valuable or curious Part of Knowledge.——For though I never heard of the Center of Pressure before, yet, as I find it is a curious Point, should be very glad to get some Notion of it.——

Clean. That you will easily do by a Vessel I have here made on purpose.——It consists, you see, of three fixed, and one *moveable Side*, which is properly connected to the others by a Piece of strong Bladder.——Into this Vessel I pour Water to the Top, and it presses out the moveable Side as far as it can go, and there keeps it in a perpendicular Position.——Now there is but one Point in that moveable Side, where you can apply your Finger to counter-act the Pressure of the Water within, where the Side will move parallel to itself, or to the Position it is now in by the Pressure of the Water—There, try the Experiment.

Euphros. I will, *Cleonicus*.——I press the upper Part, and find that won't do, because it moves faster than the lower Part.——Then I press the lower Part, and it now moves faster than the upper, so that won't do neither.——Well, now I'll press it in the middle, and see what that will do;—I find that is not the Point yet; for though the whole Side moves forward, I find the upper End goes faster than the lower.——Now I know not where to press next.——Ah, I fancy I have discovered the Plot at last. I spy a small *Speck*, or *Dot* a little lower down, I'll try that—it succeeds to my Wish—I find a uniform Pressure

sure there, and the Side goes equally forward in every Part.—Have I not hit the Mark, *Cleonicus*?

Cleon. Indeed you have, Sister; but you are beholden to me for that—for I made the Dot on Purpose that it might take your Eye, when you had tried all other Parts in Vain.—I have the Pleasure to see nothing can escape your keen Observation.—One thing more you must know, which is, that this *Center of Pressure* is always *two Thirds* of the Depth of the Fluid below its Surface.—For Instance, in this Vessel the Depth of the Water is 9 Inches, and that of the Center of Pressure, 6 Inches, of Course.

Euphros. I suppose you have by this time, pretty well exhausted this Subject—Pray what is your next, *Cleonicus*?

Cleon. That is commonly called, *the Hydrostatic Paradox*.—But don't let the harshness of the Title prejudice my *Euphrosyne* against attending to the Thing itself, which, I am well assured, to her will be no *Paradox* at all, but on the contrary, appear to be an easy and important Truth.

Euphros. I am never disheartened, *Cleonicus*, when I have the least Prospect of understanding the Subject, and as you give me such promising Encouragement, I shall attend to every thing you say, with all the Address I am Mistress of.

Cleon. I have here brought you a little Hydrostatic Instrument, for the Illustration of every thing I have to say on the Subject of this Paradox—It consists of two round Plates of Wood connected together with a fine Piece of Blue Morocco Leather, and distended by small Hoops of Whalebone on the inside, to keep it always open; and the top being raised from the bottom, you see, gives it the appearance, in a great Measure, of a Barber's *Powder-Puff*—And, like that, the top may be raised to a considerable Distance from the bottom whenever Water is poured into it—As you here see by Experiment—

Euphros. Ocular Evidence makes all you have yet said very easy to apprehend—I see no Appearance of a Paradox yet, *Cleonicus*—

Cleon.

Cleon. Have a little Patience—upon the top, in the Middle, you observe a Hole in a Piece of Brass with a Screw, into which this long Glass Tube is screwed, with a Piece of Leather to keep it Water-tight—This I screw on while the Puff is empty, and now with a small Funnel I pour a little in through the Tube, and you see the top rise up a little way from the bottom—I pour in more, and it rises still higher—I now pour in enough to raise the top as high as it can go; and where the Water just appears in, in the Tube.

Euphros. All this I see, *Cleonicus*—but no Paradox yet—

Cleon. So much the better, my *Euphrosyne*—While I hold the Tube upright, put your Hands on the top and gently press it down—The Consequence is, you see the Water rise a little way in the Tube—

Euphros. I do as you bid me, and observe the Effect—but see no Wonder in that, *Cleonicus*—

Cleon. Well, now press the top with a greater Force downwards, and you see the Water will rise higher in the Tube—

Euphros. That I don't wonder at, since the more I force out of the Instrument, the more must go into the Tube, and the higher of Course it must rise—

Cleon. Well now, my *Euphrosyne*, press with Force sufficient to raise the Water quite to the top of the Tube.

Euphros. I will—but I can assure you *Cleonicus*, I have Strength scarce enough to do that.

Cleon. And don't you see any thing in all this kind to wonder at, *Euphrosyne*?

Euphros. I can't say but I thought it appeared very strange, that I was obliged to exert so great a Force to raise the Water to the top of the Tube.—I am now sensibly convinced that the Pressure of the Water upwards, is beyond any thing I could have conceived before I heard your Lectures on the Subject.

Cleon. I shall now shew my *Euphrosyne* how the Pressure of Fluids may be estimated by this Machine.—You see here several single Pound Weights in Lead, of a round

round Form, and a Hole in the Middle for the Tube to go through them.—These are placed one after another upon the top of the Water-Puff.—Then by their Pressure, the Water will rise in the Tube to several Heights answering thereto.—Consequently those Heights will encrease equally from the bottom to the top.—At present the Vessel is just full, and the Water appears in the Tube.—I put on a Pound Weight, and the Water rises, by its Pressure, just *three Inches* in the Tube—I put on another Pound Weight; and it raises the Water yet three Inches higher in the Tube—The third Weight put on, raises it to nine Inches height—The fourth to twelve Inches; and so on to *Ten Pounds*, which it forces to the Height of thirty Inches—From every Step of this Experiment, it appears that three Inches height of Water produces a Force of Pressure upwards on the top of the Machine of *one Pound Weight*, and is *in Equilibrio* with it; and is therefore the Measure of it.

Euphros. Then if I understand you right, *Cleonicus*, any Vessel three Inches deep, and of the width of this Water-Puff, will hold just *one Pound* of Water, when full; for then the Pressure on the bottom will be *one Pound*, the same as the Pressure upwards, from three Inches Height.

Cleon. Well, I am glad to find you understand the Paradox without knowing it is one—for if three Inches Height of Water produces the same Effect as a Pound will do, then the Paradox is demonstrated.—As it appears, *[that the same Quantity of Water, however small, may produce a Force equal to any assignable one, by increasing its Height, and Base upon which it presses.*

Euphros. Well, I can't say after all, that this Paradox is any more than what you have shewn by almost every Experiment from the Beginning—And now, *Cleonicus*, I hope you have done with Paradoxes, and tell me what important Uses you deduce from this?

Cleon. The *Rational* of all Hydrostatic Machines and Instruments, depend upon it, as will be shewn in the ensuing Part of these *Speculations*.—At present I shall only entertain my *Euphrosyne* with the Reason and Experiment of one, *viz.* The *Jet d'Eau*, which is esteemed
one

one of the finest and most delightful Effects of the *Hydrostatic Science*; this you are convinced of by the grand and prodigious Variety of Fountains playing to an amazing Height, and in many different and wonderful Modes, in the Pleasure Gardens of most of the Nobility and Gentry in the World.

Euphros. I suppose, by it's appearance, that this little Instrument on the Table is a Model by which you intend to explain the Nature and entertaining Effect of a *Jet d'Eau* to me—

Cleon. It is so, my *Euphrosyne*; and I am happy to have a Pupil who will not require a long Harangue for that Purpose—This Instrument consists of a long Glass Tube, with a neat japanned Cup or Cistern upon the top, to hold Water in the Nature of a *Reservoir*.—The lower End of the Tube is turned upright, about an Inch—and upon that is cemented a Brass Cap, a small Hole in the Middle, at present stoped close with a Brass Pin.—I now place the Machine in a large *China Basin*, and fill it with Water from this Quart Pot, as you see—The consequence is, that a Pressure upwards will be produced against the top of the Brass Cap, which being fixed, will re-act downward with an equal Force; and the Fluid will be at rest.—But upon my pulling out the Pin, part of that Resistance or Re-action in the top of the Cap, will be taken away, and in lieu thereof, a *Jet of Water* must be made through the Hole, to the Height of that in the *Reservoir*, to preserve the *Equilibrium*—And thus you see a *Jet d'Eau* is made, and keeps playing, as long as I keep pouring Water into the Cistern.

Euphros. Well, *Cleonicus*, I could not wish to see a prettier Fountain in Miniature—But I observe it does not play to the Height of that of the *Reservoir*.

Cleon. No, my *Euphrosyne*, nor is it possible it should—There is a considerable Resistance to the issuing Water from so small a Hole in the Cap, which will much impede its Ascent—And Secondly, the Height of the Jet is greatly lessened by its striking against the Air, by whose Re-action it is split and divided into many slender Streams, which fall in drops, as in a *Shower of Rain*—

And

And in large Fountains which play to the Height of twenty or thirty Feet, there will appear in these *Artificial Showers* as strong and vivid a RAINBOW as ever you observed in the Heavens; and seen so near you, strikes you with it's intensely glowing Colours, far more surprizingly than the *Natural Bow*—And of this I shall give you an Instance in the Jets of Water, which gush out with such violence from the Cracks and Crevices of the Defective Pipes in the *Cold-Bath-Fields*, the next time I observe one fit for the Purpose.

DIALOGUE V.

Of SOLIDS immersed in FLUIDS. Of the DOCTRINE of Specific GRAVITIES, by EXPERIMENTS. The DESCRIPTION and Use of a New Hydrostatic BALLANCE. Of Weighing GOLD Hydrostatically, to find if it be Sterling, or Adulterated.

Cleonicus.

I Shall now have the Pleasure of explaining to my *Euphrosyne* the Manner in which *Fluids act upon Solid Bodies that are immersed into them*—Also the *Doctrine of specific Gravities*—And the *Construction and Use of a New Hydrostatic Ballance*, for discovering and ascertaining the same.

Euphros. These seem to be all grand Topics, *Cleonicus*; I scarcely understand what you talk about at present.—How then shall I understand the Things themselves?

Cleon. With more Ease, perhaps, than you imagine, my *Euphrosyne*—I have more than once hinted to you, that in the *Science of Fluids*, almost all the Difficulty consists in Words, and not in Things, which, generally speaking, are familiar to every Body, when divested of

their ancient *Grecian Garb*, and appear in a proper *English Dress*.

Euphros. Well, without more prefacing, pray *Cleonicus* proceed—I shall be the most attentive passive Pupil you could wish——

Cleon. The first *Position* I shall illustrate to my *Euphrosyne*, is this, that every Solid, immersed in a Fluid, loses just so much of it's Weight, as is equal to the Weight of an equal Bulk of the Fluid.—I shall expound the Reason of this first, and then confirm it by Experiment, as it is a Fundamental Point in *Hydrostatics*.

Euphros. Well, I find I shall have two Strings to my Bow.—If I shall not be able to understand your Reasoning, I make no doubt but the Experiment will be convincing.

Cleon. You are always very diffident of your own Understanding, my *Euphrosyne*; but that is a good Sign, for those forward Geniuses who understand every thing without teaching, seldom know any thing with it—But to the Reason of the Thing—You will observe, no Body can be immersed in Water, without raising it's whole Bulk of Water upwards—In doing that, it must overcome the Weight of that Bulk of Water—Then, since Action and Re-action are equal and contrary, that Bulk of Water, so raised, will re-act with all it's Force of Gravity against the Body immersed, and, of Course, will destroy just as much of it's Weight or Gravity.—Then it will descend only with the Remainder of its Gravity—This is all the *Rationale* of the Matter.

Euphros. I have a tolerable Idea of the whole of what you have said, *Cleonicus*; and doubt not, but an Experiment will entirely elucidate it throughout.

Cleon. I can assure you it is plain, and a perfectly decisive one—It consists in a *Ballance*, a small hollow cylindrical Bucket, and another Cylinder to be immersed in Water.—This latter Cylinder is made to fit the capacity of the Bucket precisely—The Bucket is suspended to one End of the Beam—In the bottom of the Bucket is fixed a strong Thread of Silk, with a Loop on the lower End—In this Loop the close Cylinder is placed and suspended—The Beam is then placed on its Stand—And the

the Bucket and Cylinder are then counterpoised, as you see, by a Weight at the other End of the Beam.

Euphros. This Apparatus seems to be a very curious and promising one—I long to see it applied——

Cleon. That you will instantly do, my *Euphrosyne*—— I set this Jar of Water under the Cylinder—And then I gradually lower the Ballance (by a Screw) and you see the Cylinder as gradually descend into the Water—— And at the same time you see it become lighter and lighter upon the Ballance—Till now it is quite immersed, and you observe the Equipoise quite destroyed by the Descent of the Weight on the other Arm.

Euphros. All this I notice minutely, *Cleonicus*——But how am I to understand how much of the Weight of the Cylinder is lost by the Re-action of the Fluid?

Cleon. By my adding the Weight of the same Bulk of the Fluid, that is, by pouring Water into the Bucket till it is just brimfull——And as I do this by Degrees, so you observe the Equipoise is restored by Degrees, till the Bucket is full—And then the Beam is truly Horizontal, as at first.

Euphros. I see most perfectly, that the deficiency of Weight is restored by the equal Cylinder of Water in the Bucket—I think this is as demonstrative an Experiment as I ever saw—But I have heard *Cleonicus* say, e're now, that no Part of the Gravity of Matter can be annihilated—How does that agree with this Experiment?

Cleon. Extremely well, my *Euphrosyne*——This Experiment does not shew any Weight in the Cylinder is destroyed, but only that the whole Weight is not upon the Ballance now, but a Part of it; the other Part being communicated to the Water, which by this means becomes heavier than before—The Reason is, because when the Cylinder descends, the Water rises in the Jar, and consequently presses upon the bottom with a greater Force than before.

Euphros. I see the Reason of the Thing now very clearly, *Cleonicus*——For though there be less Force upon the Ballance, there is equally more upon the Jar—And therefore the Sum total is still the same.

Cleon. Very well considered, and very well expressed, my *Euphrosyne*——And having understood thus much, you

are qualified now for the Experiments of that most useful Invention we call the *Hydrostatic* BALANCE—This, in truth, is nothing more than the *foregoing Apparatus* in another Mode, more adapted for general Use—But that which I shall now shew you, is of an entire new Form, and the Method of shewing Experiments by it, the most simple, easy, and expeditious that possibly can be.

Euphros. Well, now I shall beg of *Cleonicus* an Explanation of every particular relative to its Construction and Use—For I perceive a *new Scene of Science* is likely thereby to open to me soon.

Cleon. The Balance I Use, is that called *Money-Scales*, in a Shagreen Case, with *Money-Weights*, and *Grains*.—In the Middle of the right-Hand Scale is a small Hole, in which a Silken String is fixed at one End, and in the other is a Loop to grasp any Body placed therein, hanging below the Scale at the distance of about five or six Inches—Any Object placed in the Loop and suspended, as you see this Piece of Brass, is counterpoised with Penny Weights and Grains put into the other Scale—And thus you see the whole stand in your View ready for Use.

Euphros. You will now please to tell me what that Use is, and the Manner of performing it, *Cleonicus*.

Cleon. The Use of this Balance, is to find the Difference between the Weights of two equal Bulks of *Water* and any other Sort of Matter (as this Piece of *Brass* for Example) by weighing it in *Water*—Thus, I raise the Balance up by the Screw, till the Brass is just over the middle of the *Water* in the Jar—Then I lower it down again, that the Brass may sink into the *Water*—And then you see the *Equipoise* is destroyed, and the Scale with the Weights descends—I now put into the Scale (holding the Brass suspended in the *Water*) just so many *Grain Weights* as will nicely restore the Equilibrium—And thus I have atchieved what I wanted.

Euphros. Why all this is, sure enough, nothing more than the last Experiment repeated with a *Piece of Brass*, instead of a Cylinder, and *Weights* instead of *Water*, for restoring

restoring the Equipoise——But what have you atchieved by this Exchange, *Cleonicus*?

Cleon. I have in this one Experiment laid the Foundation on which the whole DOCTRINE of SPECIFIC GRAVITY is built; and that is reckoned as important and sublime as any in the Circuit of Philosophy.

Euphros. I fear I have not such an Idea of *Specific Gravity*, as I ought to have, *Cleonicus*——Therefore I beg you will explain it a little more at large, if you please.

Cleon. I will do as you desire me, Sister——The *Specific Gravity* or *Weight* of any Body, is that peculiar to it in a given Bulk——Thus, in the present Case, the Weight of the Piece of Brass is 2 Penny Weights and 8 Grains, (or 56 Grains), and that of an equal Bulk of Water is 7 Grains; consequently the *Specific Gravity of Brass*, is to that of *Water*, as 56 Grains to 7; that is, as 8 to 1; or Brass is 8 times heavier than the same Bulk of Water——By weighing a Piece of *Lead* in the same Manner, it will be found a little more than a 11 times heavier than an equal Bulk of *Water*; therefore its *Specific Gravity* to that of *Water*, is a little more than 11 to 1.——At the same Time that you find the *Specific Gravity of Brass and Lead to Water*, you know what they are to each other, that is, as 7 to 11, nearly——If *GOLD* be weighed in the same Manner, its *Specific Gravity* to that of *Water* would be as $17\frac{1}{2}$ to 1.——That of Pure *SILVER* nearly as 10 to 1——And so on for any other Body you weigh in *Water*.——Now does my *Euphrosyne* understand it?

Euphros. Indeed I must be dull if I did not, after so clear, so long, and so particular an Explication of it.——I think the *Specific Gravity* of *Gold*, you seemed to mention as the greatest of all other, *Cleonicus*.

Cleon. It really is so, my *Euphrosyne*——Pure *Gold* is the heaviest of all Bodies——*Platina* comes nearest to it; and *Mercury* next —— But of this more, by and by.

Euphros. I suppose by the same Ballance you discover the different *Specific Gravities* of FLUIDS, as well as SOLIDS,

Cleon. We do, and rather with more Ease—For this purpose you see here a Piece of *Glass* properly formed to be suspended from the Ballance by a *Horse-Hair*, to be immersed in any different Fluid you please.—The Body to be immersed, must be *Glass*, and it must be a *Horse-Hair* to hold it, because these Bodies will not be hurt by the Action of any Fluid upon them; not even of *Aqua fortis*, *Oil of Vitriol*, &c.

Euphros. You will please now, *Cleonicus*, to illustrate this process to me, also.

Cleon. It is thus, my *Euphrosyne*.—I connect the Glass Ball by the Horse-Hair to the right Hand Scale—And taking the Scale off the other End of the Beam, I place in its Room a Weight that counterpoises the Glass as it hangs in the Air.—Here are two Glass Jars, one of *Water*, and the other of *Spirit of Wine*—It is proposed to find the *Specific Gravity* of each of these Fluids—To do this, I, in the first Place, immerse the Glass in the *Water*, and the Equipoise is destroyed—I put in Grain Weights enough into the Scale to restore it, and that you know is the *Weight of a Bulk of Water* just equal to the Bulk of the Glass, this luckily happens to be 100 Grains—Then I immerse the Glass Bulb into the *Spirit*, the Equipoise is lost—I put into the Scale Grains enough to restore it, which are 84;—And since *equal Bulks of Water and Spirit* have their Weights as 100 to 84, those Numbers express their *Specific Gravities*, as required—On the other Hand, if I immerse the Glass in *Oil of Vitriol*, it will require 173 Grains to restore the lost Equilibrium—Hence the *Specific Gravity of Water* is to that of *Oil of Vitriol*, as 100 to 173—This Oil will be found the heaviest of all Fluids but *Mercury*, which is not a proper Fluid in its own Nature.

Euphros. I clearly understand you through the Whole—I have now a competent Idea of this famous *Praxis of finding the Specific Gravities of Solids and Fluids*—And what further Uses of this curious Ballance yet remain, dear *Cleonicus* will next inform me—

Cleon. There is no great Matter of Philosophy in weighing Money to see if it be good or *Sterling*, since

to

to do this, is only to put a *Guinea* in one Scale, and the *Guinea-Weight* in the other, and if they Equipoise each other, you know the *Money is good*.

Euphros. But supposing the *Guinea* not so heavy as its Weight, how do you proceed then, *Cleonicus*?

Cleon. My *Euphrosyne* will observe another set of Brass Weights, called *Water-Weights*, belonging to this *Money Ballance*, because, when the several Pieces are weighed in Water, they are respectively put into the Scale holding the suspended Money to restore the *Equilibrium*.—These *Water-Weights*, as well as the *Money-Weights*, have the names of the respective Pieces of Money stamped or engraved upon them.—She will next observe, that the Money may have been diminished in Weight, either by diminution, or by adulteration with a baser Metal.—Now it is one excellency of the Science of *Hydrostatics*, that it will immediately discover to which of these two Causes the defect of the Money is owing.—Thus, if I have a *Guinea* short of Weight, I weigh it in Water, with the *Guinea-Weight* in one Scale, and the *Water Weight* in the other, and then if there be an *Equilibrium*, I know that the Deficiency cannot be owing to want of Bulk, but to an Alloy with Silver, &c.—But if the Scale with the *Water-Weight* preponderate, I am at once convinced that the Bulk of the *Guinea* is diminished by *Clipping*, or Sweating it in *Aqua Regia*, or by some other Way.—Now the Weight of a *Guinea* is $129\frac{1}{2}$ Grains, and it's Value is 252 Pence; then two Pence is the Loss to be allowed for every Grain by which it is deficient.

Euphros. Such an Acquisition of useful Knowledge I little expected when you first mentioned *Hydrostatics* to me, *Cleonicus*.—But now I find, that by this Art I can be secure from suffering, in Money Matters, any Imposition and loss from *fraudulent Cheats and Coiners*.

DIALOGUE VI.

Of WATER, OIL, SPIRIT, &c. *The Rationale of SINKING and SWIMMING. The Use of Cork JACKETS. Of the Diving BELL. Of Proof SPIRIT. The Use of the HYDROMETER, or WATER-POISE, curiously made in BRASS, and of a truly Philosophical STRUCTURE.*

Cleonicus.

IN these Fields of Philosophy (so seldom frequented by the *Vulgar*) are many delightful Paths for serious Meditation and Contemplation—But those abounding with Brooks, Rivulets, and murmuring Streams are esteemed the most delightful of all; and to such we may compare the *Speculations of Hydrostatics* among the Natural Sciences—The Properties of Fluids open to us the Flood-Gates of that sort of Knowledge which relates to the *Divine Beneficence* of Providence, so conspicuous in all Parts of the Creation, and indeed, it would be impossible for Nature to exist in its present State, without a perpetual Influx of various Sorts of confluent Matter, in the Forms of *Water, Oils, Spirit, &c.*

Euphros. The Necessity of *Water*, I believe is known to every Soul living; and as to OIL, I suppose you could largely declaim upon that, if there were Occasion; and also upon the Nature of *Spirit*.

Cleon. Both OIL and SPIRIT are of the most important Use in Life—My *Euphrosyne* needs not to be told that all *Nocturnal Lights or Illumination* are owing to this Fluid burning in *Flambeaus, Lamps, and Candles*; for all Fat, Tallow, &c. are real Oils in different Forms, and Degrees of Consistence—And the Nature of Oils consist of two Particulars principally, that is, they are all *Inflammable*; and they will not mix with *Water*, whose Nature is to *extinguish Flame*.

Euphros.

Euphros. And is not *Oil* chiefly concerned in making SOAP, *Cleonicus*?

Cleon. It is, my *Euphrosyne*, in that most useful domestic Article, the chief Ingredient.—For all hard or soft Soap is made by incorporating Pot-ash with Oil or Tallow.—The Process of which you may at any time see at a *Soap Boiler's Laboratory*, not a quarter of a Mile from hence.—Again, all kinds of *Smithery Work* requires Oil, especially the *Lock Smith* finds it impossible to do without such a *lubricating Fluid*.—How great is the Use of *Oil* in *Medicine* and *Pharmacy*! Nay *Olive Oil*, of itself, is a well known *Antidote* against the *poisonous Bite* of a *Serpent*.—Lastly, in your *Diet*, how frequent is the use of *Oil* in all your dainty Dishes, your esculent Plants and Salads, to make them go glibly down?

Euphros. Indeed, *Cleonicus*, I like the *French Language* better than I do their *Diet*.—But what is the Philosophy of SPIRIT, which I suppose I am next to learn?

Cleon. Before we can touch upon that subtle Subject, we must revert to the Speculation of *Specific Gravities*, and consider more particularly the Cause of *Sinking* and *Swimming* of Bodies in Water and other Fluids.—Indeed, this has been, in Part, shewn already; for when a Body is Bulk for Bulk heavier than the Fluid, and by being immersed in it, loses only the Weight of one equal Bulk of the Fluid, then the *residual* or remaining Gravity of the Solid must carry it down to the Bottom, or make it *sink*.—On the other Hand, if the Solid has less Weight in the same Bulk than the Fluid, then it cannot by its Weight displace or raise upwards its whole Bulk of the Fluid, but only so much of it as is equal to its own Weight; and by this Deficiency of Weight, it can only be partly immersed, and therefore will *Swim* upon the upper Part of the Fluid.—If it were possible to find a Body that was equally heavy with the same Bulk of the Fluid, it would remain at Rest in any part of the Fluid in which it was placed, and so would neither *sink* or *swim*.

Euphros. I see the Reason of all you have said very clearly; and every Day's Experience confirms the Truth thereof.—I observe *Stones sink*, *Cork swims*, &c.—but pray,

pray, *Cleonicus*, how comes it to be said, *that a Fish weighs nothing in Water?*

Cleon. From want of Skill in Philosophy.—The Fish being but little heavier than Water, looses the Weight of an equal Bulk of Water, (as you have seen,) and what remains is scarce *sensible to the Hand* that holds it by a String in the Water.—Hence it is, that a Man going into a Bath, finds himself so light, that he can hardly keep himself upright.—And if but a Pound of Cork were tied about his Waist he could not sink at all.—Hence the Custom of *learning to swim by Bladders*—And hence the great Use of *Cork Jackets to Sailors* in Case of a *Wreck*, or other Accidents by which they fall into the Sea.

Euphros. How pleasant it is, as well as extremely useful, to be but moderately imbued with the Knowledge of so *necessary a Science*, by which the Lives of thousands may be saved!—But pray, *Cleonicus*, how is it that *Divers* can sustain so great a Weight of Water at the very great Depth they usually go?

Cleon. Just as we sustain the Pressure of Air, which (as I formerly told you) was not less upon every Person than *13 Ton Weight*.—And since the Pressure of Water upon a *Square Foot* is 1000 Ounces at the depth of *one Foot*, it will be 32000 Ounces at the depth of 32 Feet.—Now upon the Body of a middle sized Man, there are about 10 *Square Feet*; and consequently at the depth of 32 Feet under Water, he must sustain the Pressure of 320000 Ounces, which is 20000 *Pounds Averdupoise Weight*, and is almost equal to the Pressure of the Atmosphere.—Hence it is very necessary to let the *Diver* up and down very slowly and equably, that the Air within him may be gradually condensed or expanded; and then the *Diver* can suffer no great Inconvenience.—Dr. HALLEY tells us he drank a Bowl of Punch, and read a News-paper in his Bell (at the Bottom of the Sea), which had a large Convex Glass to give Light on the Top, by which was a Stop-Cock to let out the *warm contaminated Air*, while the *cold pure Air* entered the Bell at the Bottom, by Means of a Leathern Pipe from the Ship.

Euphros. Well, I never knew that one might live and enjoy himself so voluptuously at the Bottom of the Sea before.—

before.—Much good may it do them, with all the Riches they get from the Wrecks.—I wonder at the Courage of the *amphibious Diver*, more than at that of the *most intrepid Son of Mars*.—But pray, *Cleonicus*, what is the next Instrument that I am to learn the Use of?

Cleon. It is called the *HYDROMETER*, *Water-poise*, or *Spirit-prover*, as it is applied to discover the *comparative Density of Fluids* on which their *Strength and Virtue* principally depends.—You see here one in *Ivory* for common Use, and another in *Brass* for critical Purposes—That in *Ivory* consists of three Parts, the *Body*, the *Tube* below, and the *Stem* above—all connected together by Screws.

Euphros. Pray be so good as to unscrew them for me to inspect each Part separately, the better to know their Use, *Cleonicus*?

Cleon. That I shall do instantly.—The *Body* is round or globular, and hollow, to render it *boyant in Water*.—The *Tube* that screws on below, is to hold fine *lead* Shot, closed with a *Cork*.—And the *Stem* which screws on upon the *Top* is *truly cylindrical*, and divided into 20 equal Parts by *Black Circles*.—Now for examining all kinds of *Medicinal Waters*, the *Weight* of the *Shot* must be such as will cause the *Hydrometer* to sink in *Rain Water* just to the middle of the *Stem* or *Number 10*.—If then it be put into any *Spring*, *Saline*, or *Medicinal Water* (which is always heavier than *Rain Water*) it will not sink so deep.—And thus by observing the various depths to which the Instrument sinks into them severally, you will discover their different *Gravities* above that of *Rain Water*, which is the least of all.

Euphros. Such Discoveries must make the *Hydrometer* of very great Importance to *Gentlemen of the Faculty*, *Cleonicus*.

Cleon. Undoubtedly, my *Euphrosyne*.—But it is still of much greater Consequence in *Commercial and Domestic Affairs*, in which *Spirituous Liquors* are concerned, as *Brandy*, *Rum*, *Arrack*, and *Spirits* of every kind.—For the Nature of this Instrument is such, when made as it ought to be, that it will immediately discover when *Spirit*

is

is pure and genuine, and when mixed with *Water*.—Also in what proportion that Mixture is made, and the *Quantities* of *Spirit* and *Water* contained in any *Compound Spirit* proposed.

Euphros. Now you are upon the Subject of *Spirits*, *Cleonicus*, I should be glad if you would tell me what that is you call *Proof Spirit*, as I have heard it often mentioned in Conversation?

Cleon. I will my *Euphrosyne*.—But you must first know, when the Spirit is pure and unmixed, and that you will find at any time by an easy Experiment thus:—*Pure Spirit* is the most inflammable of all Fluids, and will take Fire at the Flame of a Candle, instantly.--Therefore I pour a little *Spirit of Wine* into this Silver Spoon, and setting it on Fire, you see it burns all away very soon, and leaves the Spoon quite dry; which shews it is very pure, and without any mixture of *Water*; for if there had been any, it would have remained in the Spoon.

Euphros. This is a Proof of its Purity indeed—but pure Spirit, I apprehend is not what you call *Proof Spirit* yet, *Cleonicus*.

Cleon. I shall now inform my *Euphrosyne* what that is.—Spirit is too active or strong a *Liquor* to be drank alone, and requires to be mixed with *Water* to lower it down, till it becomes a palatable Drink, in such a Manner or Form as we usually call a *Dram*.—For this Purpose, the *Spirit* is mixed with an equal Weight of *Water*; and then this Compound is called *PROOF-SPIRIT*.

Euphros. So that when the Spirit is *Proof*, it is shewn I suppose by this *Brass Hydrometer* which I here see, and is of a different Make from the Ivory One in many Respects.

Cleon. It is required to examine Spirituous Compounds with the utmost exactness.—Hence the Divisions upon the Stem are different here; and one of them, (No. 10,) is the *Proof Point*.—Here are also several Weights to be applied in a small Concave, upon the Top of the Stem.—These Weights divide the Difference in the Strength of the Compound from the State of all *Water* to that of all *Spirit*, into a thousand equal Parts.—These Weights are 9 in Number, viz. 400, 300, 200, 100; and 40, 30,

20, 10.—And the particular Weight 600, which is the *Proof Weight*, or that which sinks the Hydrometer to the *Proof Point* on the Stem.—By these Numbers, and the 10 Digets on the Stem (1, 2, 3, 4, &c.) all or any of the Differences in Strength from *all Water* to *all Spirit* may be exprest, and immediately shewn by the Instrument, to a *thousandth Part* of the whole.

Euphros. This is a prodigious Exactness indeed.—If *Cleonicus* could oblige me with an Example or two of its Use, I should be glad.

Cleon. That I will do directly.—In the first Place, my *Euphrosyne* will observe the Compound in this Jar is just *Proof*, because the Weight 600 put into the Cup; sinks the Hydrometer to No. 10 on the Stem.—Secondly, I pour some Water into that *Proof Spirit*; and then placing the Hydrometer into it, I put 320 Grains into the Cup on the top, which sinks it to 4 on the Stem; then the whole Weight 324 shews the Degree of Strength in that Compound is much under *Proof*.—Here is now another Compound, in which the Hydrometer expresses the Strength by the Number of Weights 795 (that is 790 in the Cup, and 5 upon the Stem); so this you see is above *Proof* considerably.

Euphros. I am sufficiently convinced of its Use by these Examples, *Cleonicus*, but you told me it could also be known by these Numbers, what Quantity of Water or Spirits is to be added to make the Compound *Proof* at any time.

Cleon. Yes they can; but this is done by a Table of Numbers ready calculated to every Grain Weight, from 1 to 1000.—But our *Merchants*, *Commissioners of the Customs and Excise*, *Distillers*, &c. are, in general, content with Instruments and Methods *less mathematically exact*, than this here described.

Euphros. Well, I think myself very happy, *Cleonicus*, that I can tell by *Hydrostatics*, when I have *Good Money* and *Good Spirits*.—I think that is enough for me at present; so adieu, till we meet again.

DIALOGUE VII.

Of PUMP-WORK in General. The Rationale of the Common WATER-PUMP, and of the Forcing PUMP. Of the WATER-WORKS at LONDON-BRIDGE. Of the FIRE-ENGINE. Of PAPIN'S DIGESTOR. Of the STREAME-ENGINE for extinguishing FIRE, Watering GARDENS, &c.

Eubrosyne.

I Understand by what you said this Morning at Breakfast, that our next Speculations were to be on the Nature of Pump-Work in general, and its Application to the various Arts and Uses of Life—But did you not some time ago, *Cleonicus*, explain to me the general Reason of the Action of a *Water-Pump* by an Experiment of the *Air-Pump*?

Cleon. I did, my *Eubrosyne*, but it was in a very cursory Manner—This is not to be thought sufficient, without the Addition of some other Considerations, to compleat your *Hydraulic Studies*—For, supposing I were to ask my *Eubrosyne*, from what Depth the Water can be raised from the Well into the Cistern of the Pump, what would you say?

Euphros. Say, why my answer would be very ready, —*Cleonicus* has not yet taught me to know that.

Cleon. Well then, the following Experiment will put a proper Answer into your Mouth.—You see here a Glass Tube 3 Feet long, and near an Inch wide—Into this Tube I pour a little Mercury, to stand about an Inch high at the bottom.—Into this large Tube, and the Mercury, I put a smaller one, open at both Ends—Then I pour in Water between the two Tubes to stand quite to the top of the large one.—This done, you observe the Pressure of the Water will raise the Quick-
silver

silver a small Height into the lesser Tube, and there it will rest.

Euphros. I observe all you say, *Cleonicus*, but how does this effect Pump-Work?

Cleon. I'll tell you how, presently, my *Euphrosyne*—You see the two Fluids are at rest in the Tube, while they mutually press against each other—There is therefore an equal force of Gravity between them at the Orifice of the small Tube below—Consequently the Quantity of Matter in the short Column of Mercury is equal to that of Water in the Column of the same size, and of the Height of that in the larger Tube—Whence the *Density* and *Gravity* of Mercury and Water are inverfely as their Altitudes.—These Altitudes, if measured, are as 14 to 1; so that the *Specific Gravity of Mercury is to that of Water* in the same Proportion—You know by the *Barometer*, that the Pressure of Air raises the Mercury to $29\frac{1}{2}$ Inches, it will therefore raise Water in the Pump 14 times as high, that is, to 413 Inches, or $34\frac{1}{2}$ Feet—Now you see the *mean Height* to which the Water can rise in a Pump that is perfectly *Water-tight*.

Euphros. I do, and am not a little pleased with it—And now I believe, *Cleonicus*, I understand pretty well the Action of a common *Sucking Pump*—I presume by the curious Model I here see on the Table, you can shew the whole Operation thereof in a more compleat and Natural Manner than I could learn it from the *Air-Pump*.

Cleon. You may by this Model see the very same as in a Pump at large, and the Reason of every Part of the Process—First, here is the Jar of Water, representing the *Well*—Then a small Glass Tube is screwed into the lower Part of the Barrel, which is the Pipe going down to the Water in the Well—The *Glass Barrel* above, with its *Piston* or *Sucker* you see will receive the Water from the Pipe, and raise it into the Cistern at the top, which has the *Handle* fixed on one Side, and a *Spout* on the other, by which the Water runs off into the *China Basin*, as it does from the *common Pump*, into your *Pail*.

Euphros.

Euphros. Well, *Cleonicus*, now let me see the whole Process from Beginning to End.

Cleon. That I will my *Euphrosyne*.—The Sucker is now close upon the bottom of the Barrel, upon which I pour a little Water to keep it tight.—The Pipe being now in the Water of the Jar or Well, I raise up the Sucker with the Water above it, and the Air in the Pipe will follow it into the Barrel, by its Expansion or Spring.—The Air in the Pipe thus rarified, presses less on the Surface of Water within, than the *Atmosphere* does on that without in the Well, and consequently the Water must rise in the Tube, till the Air within is just as dense as that without, and there it will Rest between the two equal Pressures.—The Valve at the bottom of the Barrel which opened upwards to let the Air in the Pipe come in, shuts very close down, when I depress the Sucker, and so preventing any return, obliges it to rise through the Valve of the Sucker, and bubbling through the Water escapes, and mixes with the common Air.—All this you see is the Effect of the First Stroke; and the same is produced by the Second, the Third, &c. till the Water in the Pipe, you see, reaches the bottom of the Barrel, and then by every Exsuction afterwards, it enters the Barrel, then the Cistern, and lastly runs out of the Spout.

Euphros. Well, you have now given me a perfect Idea of a common House Pump.—I little imagined there was so much of the most curious Part of Philosophy concerned in its Operation.—And pray, *Cleonicus*, is there any other Sort of Pumps of distinguished Note?

Cleon. Yes, greatly so, my *Euphrosyne*.—One is called the FORCING PUMP, because, it not only draws the Water into the Barrel by *Suction*, as in the common Pump, but it afterwards forces it up into a Reservoir in a lofty Situation.—The action of this Pump will readily appear by the Model of it which you here see.—The Pipe and Barrel are the same as in the other.—But the Sucker has no Valve in it for Water to pass through.—Then you observe, at the bottom of the Barrel a long Tube is cemented into a Socket, and has on the top a Cistern, into which the Water is forced through this

Pipe

Pipe—I shall now work it, and you see the Effect as I have described it.

Euphros. I do very plainly indeed—I see the Water once entered the Barrel, is forced through a Valve at the bottom to the Cistern on the top, where it runs into the Reservoir—But I observe, *Cleonicus*, that if the Height of the Reservoir be considerable, the Weight of the Water in the long Pipe will be so too; and soon prove superior to the Force of a Man applied to raise it.

Cleon. These Pumps are rarely used, but where the Agency of *Water*, *Fire*, or *Air*, is employed to raise vast Quantities of Water for Public uses, as at the *Water-Works* at *London-Bridge*—The *Fire Engines* in *York-Buildings*, and that in the way to *Chelsea*—*Newsham's Water-Engines* for extinguishing Fires, &c.—For all these Public Purposes, the unlimited Powers of Nature are, at the *Fiat* of PHILOSOPHY, employed most effectually whenever wanted.

Euphros. I should be glad to have a little Sketch of the Manner in which Water is raised by these wonderful Agents and Engines, if it be not troubling my dear *Cleonicus*, too much.

Cleon. The more trouble, the greater the Pleasure, my *Euphrosyne*—The *WATER-WORKS* at *London-Bridge*, at each End, you may see every Day, and observe the very large Wheels that are constantly kept in Motion by the Prodigious force of the Water upon them as they flow, by the Tide, up and down the River—For the Machinery is such, that the Wheels move either way, as the Water runs—You will there observe the Manner in which the Wheels turn the *Cranks* which move the Forcing Rods in Barrels of cast Iron 7 Inches Bore, and 120 Feet high, to the Reservoir on the upper Part of the Building.—These Engines on the *City Side*, raise about 140 thousand Hogsheads of Water *per Day*, to supply all those Parts of the City that are below the *Level* of the Reservoir.

Euphros. What surprising things are to be done by Art, assisted by Nature!—I remember you said the same

Effects are produced sometimes by FIRE-ENGINES, can you make me sensible how that is done, *Cleonicus*?

Cleon. I make no doubt but I can make my *Euphrosyne* sensible of any thing which depends upon Principles of Philosophy she has already learned——But there is one great (I might say *infinite*) *Power* of Nature, which has not yet been particularly considered in our Dialogues, and which yet is a principal Agent in the *Fire-Engine*.——What I mean, is the incredible expansive Force of STEAM, raised immediately from *Boiling Water*, and confined in the Top of the Vessel above the Surface.——I have formerly observed to you, that Heat and Fire separate the Parts of all Bodies, and most easily those of Fluids, giving them at the same time, a great Degree of Elasticity from the *Repulsive Power* between the Particles.

Euphros. The Nature of *Elastic Steam* and its great Force, I can pretty well conceive, but pray tell me how it is applied in this Engine to *raise Water*, *Cleonicus*.

Cleon. In order to this, my *Euphrosyne*, you must understand, that there is a large strong *Beam of Wood*, liberating freely on a fixed Center or Axle.——At one End of this Beam, the Rod of a *Sucking or Forcing Pump* is connected.——And at the other End, the Rod of a very large Piston, moveable in a Cylinder of Cast Iron, 7 or 8 Feet high, and 4, 5, or 6 Feet wide.——This vast Cylinder is placed upright over the middle of the Boiler, and connected with it by a Stop-Cock, by means whereof there is a Communication between the Boiler and the Cylinder.——The Broad Piston is nicely wrought, and so accurately adapted to the Barrel, that it is perfectly *Air tight* by supple Leather, &c. upon its Circumference, and is always kept so by a little Water upon it.——Upon the upper Part of the Boiler, is a Valve, with a Weight upon it to keep it close, till the Elastic Steam within has a Force just equal to the Pressure of the Air without, and then it will force up the Valve and escape.——At this time the Piston being supposed at the Bottom of the Cylinder, the Cock is turned, and the Steam acting against the Piston with a Force upwards, just equal to the Pressure of the Air upon it downwards, puts it in a State of *Equilibrium*.——Then the very great and much superior Weight of the
Iron

Iron Rod at the other End carries it down, and raises the huge Piston in the Cylindric Barrel nearly to the Top—the Steam follows the Piston, and fills the Barrel at once.—Then a *Jet of Cold Water* is let into the Barrel, and instantly the Steam is thereby reduced to a little Water in the Bottom,—and now a Vacuum being made in the Barrel, the Weight of the Air upon the Piston drives it down with incredible Force to the Bottom—and by this Means raises the *Piston of the Pump* at the other End of the Beam.—Then the Cock is turned, and the Steam let in again; and so the Action of the Engine is continued.

Euphros. Well, this is the most August Idea that I have yet had of the Power and Effect of *Art and Nature conjoined*.—I see very clearly the Reason of every Part of the Process.—And I observe, *Cleonicus*, that either *Sucking* or *Forcing Pumps* may be worked by this Engine.

Cleon. They may, my *Euphrosyne*,—In *Cornwall* they are employed to draw the Water off the Mines by Exhaustion.—But in the Stream-Engine at *York Buildings*, *Pimlico*, *Islington*, &c. the Pumps force Water into Reservoirs, for supplying the City, and Parts adjacent.—I shall very soon shew you the whole Structure and Performance of that Engine in our Walk to *Chelsea*.—And you will be amazed to see the Engine *work itself*, as if it were a *living Creature*.

Cleon. Then you will gratify me indeed, *Cleonicus*.—The great Power of the Air's Pressure I know pretty well.—But that of Elastic Vapour or Steam I had not so minutely considered before.

Cleon. Nor have you yet so compleat an Idea of it, as another Machine will give you, which is called The *Digester*, but mostly *Papin's Digester*, from its *Inventor* Monsieur PAPIN.—It is a strong Vessel made of *Copper* or *Iron*, and fitted with a thick close Cover, which is fastened down by several Screws, so as to quite keep out the *Air*, or rather *Steam-tight* in great degrees of Heat.—To render it safe when used, there is on the Cover a Valve, to let out the Steam when too violent.—This Valve is kept down by a *Steelyard* and a *Weight* moveable upon it, by which such

Degrees of Strength may be given to the Steam within, as is necessary to answer all Purposes.

Euphros. And pray, *Cleonicus*, what Purposes can those be which require such prodigious Force of Steam?

Cleon. Such as make a Species of COOKERY, as my *Euphrosyne*, nor her *Mother* before her, were ever used to.—In short, it is designed to cook or digest Bones, Cartilages, Gristles, and all the hardest Parts of Animals, in a very short time reducing them all to a *Jelly*, which when cold you may cut with a Knife, and is covered with a large *Cake of Fat*.—This is really the *most essential Part* of Animal Substance; the *Flesh and common Fat* being only the coarser and grosser Parts.—In regard to *Nutrition*, no Aliments can compare to those which the Digestor produces in less than a quarter of an hour.—But alas, Sister, it is here, as in many other Cases, the best things for want of being known, are overlooked and neglected, to the great Disparagement of Human Nature!

Euphros. This is a new Sort of *Cookery* indeed, *Cleonicus*.—I'll give you my Word I should not like to stand *Cook* to such a *Kettle* as that.——And had rather by much take your Word, than even to see an *Ox-bone dissolved* in your *Digestor*.

Cleon. Well then we'll have done with *Steam Engines*, and turn our Thoughts to what are properly called STREAM ENGINES, though these are sometimes called *Fire Engines*, from their being used to extinguish Fire in Buildings.—But in regard to this Engine, my *Euphrosyne* has already seen the Rationale in the Use of the *Condensor and Air-Gun* in a former Dialogue, as it wholly consists in the *Force of condensed Air*.—For in this Engine there is a large *Copper Vessel* called the *Air-Vessel*, of nearly a cylindric Form; into this upon the Top is screwed a hollow Pipe, which reaches near the bottom of the Vessel, with a Stop-Cock above on the outside—to which is affixed a long leathern Pipe, with a Part at the End perforated for Water to issue out in a proper *Stream* when the Engine works.—In the Body of the Engine are fixed two *Forcing Pumps*, worked by a Lever with Horizontal long Handles at each End.—The Engine is supplied with plenty of Water, where it can be had, by
a Pipe

a Pipe of Leather, Pails, &c.—The several Men, then, at each Handle, begin to force Water into the Copper Vessel, and thereby condense the Air above, till it has sufficient Force to throw the Water through the Pipe in a *rapid Stream* upon the distant Fire.—When the Air is so much condensed by the Water as to fill but $\frac{1}{2}$ the Vessel, the Spring will be strong enough to force it in a *Stream* to nearly the Height of 30 Feet.—If it be further condensed so as to fill but $\frac{1}{3}$ of the Vessel, it will then project a Stream to the Height of near 60 Feet.—If condensed so far as to possess only $\frac{1}{4}$ of the Air Vessel, its Force will be so very great as to throw a Stream near 90 Feet.—All these Projections, or *Jet D'eau*s, are supposed to be made in the Perpendicular—but in the Cases of Fire, the Direction of the Stream is in every way *obliquely* as the Fire requires.—There are no Houses or Buildings in general so high, but what a good Engine will throw the Water over them.—But as extinguishing Fires in this Way is but too common a *Phænomenon*, you may at any time observe the *Manœuvre* of the whole Process.—And for the Purpose of *Watering your Garden*, making *Jet D'eau*s, &c. I have a curious *Model now making in Glass*, for my *Euphrosyne's Use*.

DIALOGUE VIII.

Of the great FORCE of WATER converted into STEAM, shewn by the ÆOLIPILE. Of the RECOILING of GUNS, the Flight of ROCKETS and other MOTIONS of FIRE-WORKS. Of a simple retrograde WATER MILL. Of the SPOUTING of FLUIDS. Of the different Sorts of common WATER MILLS. Of the SINKING of a Body by its own WEIGHT only, and how far.

Cleonicus.

WE have not yet finished our Speculations on the wonderful Effects produced by the infinite Powers of Nature, which are no where so frequent and conspi-

cuous as in *Fluids*.—My *Euphrosyne* has, in some Measure, been instructed in the Nature of Fluids in general, and in most of their wonderful Properties.—In our last Conversation, she saw Water conveyed in a Stream to *extinguish Fire*.—I shall now, on the contrary, shew her how the same Fluid (*Water*) may be converted into a *Stream*, or rather *Steam*, to *excite the Fire*, and give it the utmost *Force of glowing Heat* it is capable of.

Euphros. This I should like to see, as I have never yet heard of, or seen any thing that will *blow or excite the Fire*, but a Pair of *Bellows*, which you have formerly very fully explained to me, *Cleonicus*.—

Cleon. The Bellows when large, and of a double Construction, such as are used in our *Iron Foundries*, and other great *Works of Metalurgy*, give such a prodigious and constant Blast of Air to the Fire in the Furnace, as will soon melt the Metal be it what it will.—But the Machine I am now going to describe and shew the Effect of, is but small in Bulk, but wonderfully great in Energy.—See, there it is, my *Euphrosyne*.

Euphros. By your Description, *Cleonicus*, I expected to see something very extraordinary.—But I see only a Copper Ball, of an oblong Form, with a Pipe tapering to a small End, turned into a Curve at right Angles to the Pipe itself.—And pray what mighty Effects can this produce?

Cleon. You will see by and by—I shall shew my *Euphrosyne* first how I prepare it for Use.—The Vessel and its Pipe being hollow, with a very small Hole at the End, I place it on the Fire to heat it; and by this Means a great Part of the Air will soon be expelled.—Then I take it off the Fire, and plunge the small End of the Pipe into this Basin of Water.—Thus just as much Water will enter into the Body, as is equal to the Air driven out.—With this Water in it, I set it again on the Fire, and direct the End of the Pipe to another Part, where the Fire wants to be excited.—And now observe the Event.

Euphros. I will, *Cleonicus*—I see nothing as yet—now I see the Drops begin to fall—then I observe a Steam issue out—which seems every moment to encrease with great

great Violence.—It becomes much finer—so rare that it looks more like a *Blast of Air* than *Water*.—It begins to blow the Fire—It blows it now very furiously and constantly.—Good lack, I am almost afraid to stand near it, *Cleonicus*!

Cleon. Don't be afraid, nothing shall hurt my *Euphrosyne* —It will keep up this *equal Blast* upon the Fire for 20 Minutes, and more.—But it now heats the Room so much, that I must open the Door to let in *fresh Air*.—I shall now take it off the Fire with the Tongues, and lay it upon the *Floor*.—Then view its *rapid retrograde Motion*—

Euphros. O Lud! O Lud! O Lud! *Cleonicus*—'Tis well you opened the Door, for I can't bear the Room, while that *Spit-Fire Fizzig* is in it.—It makes me tremble like *Quiver Grass*.

Cleon. Hey Day, my *Euphrosyne*! why you have not spirit enough for a Philosopher, if you can't stand such a Brush as this.

Euphros. Indeed *Cleonicus*, I never was so scared in my Life.—Pray what do you call this *Whirly-Gigg* thing of yours?

Cleon. The *Æolipile* or (in Greek) The GATES OF *ÆOLUS*, the God of *Winds*, *Tempests*, and *Hurricanes*, among the Heathen.—This Instrument is sometimes used in a large Size, to keep up an intense Fire for many Hours together in some Parts of *Metalurgy*.—It gives the most evident rationale of the *Recoiling* of Guns.—The Motions of *Fire-Works*, and mounting of *Rockets* in the Air.—Of the most simple Species of *Mill Work* by a *Retrograde Motion*, &c. &c.

Euphros. I should be glad if *Cleonicus* would please to be a little more particular in these important Points.

Cleon. I will—my *Euphrosyne* knows that the Steam in the bended Part of the Pipe of the *Æolipile* presses every way equally.—That the Pressure *forwards*, where the Pipe is open, meets with *no Resistance*, and there the Steam is thrown out with Violence.—But the Pressure *backwards* by the fixed Parts of the Pipe, exerts its full Force upon the Neck of the Pipe, and forces it round in that surprizing *retrograde Motion* you see.—Now the Case is the same

in a Gun, where the Powder when kindled has an infinite explosive and elastic Force, which has a free Exit *forward*, and is wholly spent upon the Bullet or Ball which it throws to a great Distance.—But the Action of this Force *backwards*, is resisted by the Breech of the Piece, which thereby *recoils* with an equal Force.—As to PYROTECHNY, or the *Art of Fire-Works*, it is wholly founded upon the same *Principle*—for the prepared Powder is disposed and rammed hard into Cases, open at one End, and close at the other, and when fixed on moveable Wheels, and lighted with a Match, they give a retrograde Motion to those Wheels which scatter their luminous and fiery Contents all around, to the Amusement and astonishment of Spectators.—So ROCKETS fixed to the End of large Sticks (to keep them upright) with the open End *downwards*, and the close one *upwards*, will, when fired, rise with incredible Velocity, and to an amazing Height in the Air.

Euphros. How easy things are when they are understood.—But *Cleonicus* mentioned also a peculiar Sort of WATER-MILL, that worked upon the same Principle.

Cleon. I did so, my *Euphrosyne*; and a peculiar one it is indeed; working *without a Wheel*, and with a *small Stream of Water*.—That you might have a correct Idea of its Structure and the Oddity of its Operation, I have a Model thereof on Purpose to shew you the whole in one View.—In the Middle of the Wooden Frame, you observe an upright small Brass Tube, moveable about a Brass Wire, passing through the Frame above, and an Horizontal Trunk below, into which it is firmly fixed; but on the outside it has a fine Point on which it turns in a Pivot-hole in the lower Part of the Frame.—The upright Cylinder is fixed into the middle of the Horizontal Trough.—This Trough has a Hole at each End, but on opposite Sides.—And therefore when I pour Water into the Cistern at the Top, it fills the Machine, and runs out at the two Holes in the bottom Trunk—and in doing this, must give it a *retrograde Motion* about the Axle or Wire.—Now see it Work.

Euphros. I do with much Pleasure, *Cleonicus*.—I observe as long as you supply it with Water, so long it keeps
whirling

whirling round backwards, like the *Æolipile*, but not in such a hissing frightful Manner.—But how is this after all applied to Mill-Work?

Cleon. I will tell my *Euphrosyne* how.—The Essential Parts of a Corn-Mill, are two large round Stones, one of which is fixed, and the other moveable upon it by an Arbor passing through the Center of the said fixed Stone.—This Arbor is the Axis of a *Trundle* which is turned by a large *Cog-Wheel* fixed upon the Shaft of a great Water-Wheel in common Water Mills.—Now if this Cog-Wheel were placed upon the Axle of a Mill at large in the Form of this Model, the same Power might be given to it as in any other Mill, and it would turn the Trundle with the Mill-Stone upon it, with the same Force and velocity for grinding Corn, as in any *Wind or Water-Mill* whatever.

Euphros. Though I have never seen (at least never minded) the Construction of a Mill, yet I see the Nature of it in your Description, plain enough to be convinced that this Model, made at large, with the Cog-Wheel, Trundle, and Mill-Stones, and a good Supply of Water, must make a compleat Mill, and I should think more simple than any other, and therefore less expensive.

Cleon. I wonder a little that I never yet heard of so promising a Machine being applied to Mill-Work.—But as the Method of working Common Mills by Water is of a philosophical Consideration, my *Euphrosyne* ought to be made in some Degree acquainted with it.—And I think that Instrument which is commonly used to shew the Nature of Fluids spouting through Holes in the Sides of a Vessel containing it, will do very well to facilitate the Idea thereof.

Euphros. I suppose, *Cleonicus*, this tall *Brass Cylinder* standing in this long Trough, with several Holes and Pegs to stop them, is the Implement you speak of.—

Cleon. It is so, my *Euphrosyne*.—The Holes in the Side, when the Tube is full of Water, and the Pegs taken out one at a time, will give Vent to the Water, which will then spout through with different Velocities and to different Distances upon the Horizon, or Bottom of the Trough.—These Distances to which the Water will
be

be projected on the Horizon, *will be always* as the Distance of the Holes from the Surface of the Water multiplied by its Distance from the Bottom.—For Instance, suppose the Tube be just 12 Inches high, and the Holes at every 2 Inches from the Top, or 5 in all.—Then the Distance to which the Water will spout from the first Hole, will be as 2 by 10, that is as 20.—But from the 2d Hole it will be as 4 by 8, or as 32.—And from the 3d or middle Hole, it will be as 6 by 6, or 36.—From the 4th Hole, it will be as 8 by 4, or 32.—And from the 5th, it will be as 10 by 2, or 20.

Euphros. So then I find the greatest Jet will be from the Middle One; and from the two which are equally distant above and below, the Water spouts to the same Distance.—Is not this the Case, *Cleonicus*?

Cleon. It is, or would be precisely so, were it not for some Resistance from the sides of the Holes, and from the Air.—Thus you observe, when I pour in Water to the top and pull out the upper and lower Pegs, the Water projects to the same Distance nearly, from both the Holes.—Again, from the 2d and 4th Holes, the Water spouts to an equal Distance, but greater than before.—Again, I take the Peg out of the middle Hole, and the Water from thence spouts to the greatest Distance of all.

Euphros. I see every particular Case verified by the Experiments, and very curious they are—but how do they relate to *Mill-Work*, *Cleonicus*?

Cleon. In these Experiments nothing relates to that but the Force by which the Water issues from the several Holes.—This Force my *Euphrosyne* readily perceives is small at the first Hole—much greater at the middle one—and greatest of all from the lower one.—Now, suppose a Wheel with Float-Boards set assaunt, and close by the Sides all round, and 10 Inches high, were placed under the first Hole, then would the Water flow out upon the top of the Wheel, and fill all the Buckets on the farther Side, which by the great Weight thereof, would cause the Wheel to descend, and turn continually round.—And this is the Case of what is commonly called an OVER-SHOT MILL, where the *Velocity* of the Water is but small, but the *Weight* very great.

Euphros.

Euphros. But if you let the Water out of the middle Hole upon the Wheel, I suppose the Velocity there is very considerable, and will add greater Force to the Wheel.

Cleon. It will, my *Euphrosyne*, especially as it acts in conjunction with a much greater Quantity of Water that goes out in a given time.—So that the Water now not only acts by its Weight in the Buckets, or Floats upon the Wheel, but also strikes them with a considerable Force, according to the Height of the Water above.—When the Water comes upon the Wheel in this Manner, it is called a BREAST-MILL.—When the Water goes through the Sluice at the bottom of the Mill-Pond Head, it has then the greatest Force upon the Floats to turn the Wheel, and work the Mill.—And in this Case it is called an UNDER-SHOT MILL.—And thus much may suffice for the Philosophy of those noble Works of Nature and Art, which afford my *Euphrosyne* the Materials for making us BREAD, which is the *Staff of Life*; besides *Puddings* and *Pasties* in abundance.

Euphros. I find, *Cleonicus*, you make *Philosophy* the foundation of all *good Living*, as well as *good Sense*.

Cleon. If my *Euphrosyne* looks but a little way from Home, she may be convinced of that every Day.—But one thing I forgot to apprise you of in its proper Place—and lest you should at any time be posed with a Query of that Sort, I shall try you with it now.—Pray how far will a heavy Body sink by its own Weight in Water?

Euphros. Why to the Bottom, to be sure, *Cleonicus*, what should hinder it?

Cleon. Why I believe most People would think, and answer, as you do, my *Euphrosyne*.—I will tell you what will hinder it, the *Pressure of the Water upwards*.—For after a heavy Body is placed so many times, its thickness under Water, as it is heavier than Water, the *Pressure of the Fluid upwards upon the under Surface is greater than the Weight downwards*, and consequently below that Depth, if you keep the Fluid off the Surface, no Body can sink in it by its own Weight, though ever so heavy.

Euphros. I find, *Cleonicus*, if one would talk philosophically,

phically, he must take great Care how he places his Words.

Cleon. Or rather, *how he expresses them*—and yet no greater Skill in Criticism is here required but to *speake with Propriety*; which every other Subject requires as well as this.—My *Euphrosyne* will comprehend me better, if I illustrate this *Paradox* by Experiment.—You see here a Tube of Glas 10 Inches long, and an Inch and half wide, truly cylindrical.—Also a round piece of Lead of equal width with the Tube, and of an equal thickness every where.—In the Center thereof is fixed a *Silk String*—And to the upper Surface of the Lead is adapted nicely a piece of *Leather*, soft and well soaked.—The lower End of the Tube, and the upper Surface of the Lead, are both ground truly flat, and are thus made Water-tight with the Leather between them.—Lastly, upon the lower Part of the Glas Tube are drawn 12 Circles, or Rings round it, at a Distance equal to the Thickness of the Lead.

Euphros. I see every Part well adapted to answer the Experiment you intend to oblige me with; therefore, pray, *Cleonicus*, proceed.

Cleon. The first thing you are to observe, my *Euphrosyne*, is, that the Lead is to be put *into* the Water, but not *under* it, that is, there must be no Water in the Tube above the Lead.—The Water I keep off, by putting the String through the Tube, and thereby drawing up the Lead close to the End.—Then I immerge the Tube with the Lead at Bottom, in this Jar of Water, and you see no Water rise therein.—Now you see the Lead is *in the Water*, but not *under it*, because there is no Water *over it*.—If I put the Tube and Lead so far down, that the Surface of the Water may touch any one of the Rings (except the uppermost) and then slacken the String, the Lead will sink in the Water.—Thus, I place it to the 8th Circle, and the Weight sinks, but can you tell me why, my *Euphrosyne*?

Euphros. You love to puzzle me sometimes I find, *Cleonicus*.—But let me see, the Pressure of the Lead downwards is equal to 11 times that of the same Bulk of Water, as I remember you told me.—Now in this Case, the

the Pressure of the Water upwards against the Lead is but equal to 8 such Bulk of Water.—Consequently the Pressure of the Lead downwards is considerably greater than that of the Water upwards, and there *must sink* when you let go the String.

Cleon. Nothing can be better conceived or expressed, my *Euphrosyne*.—You see I relax the String, and down goes the Lead immediately.—But now I'll put it on again, and place it in the Water to the 12th Circle.—Here I let go the String, and the Weight does not descend or sink.

Euphros. I see it does not; and I see at the same time why it cannot.—For now the Pressure of the Water upwards upon the Lead is as 12, whereas that of the Lead downwards is as 11, and therefore cannot sink down.

Cleon. Very good, my *Euphrosyne*—Now you see demonstrated what was first proposed.—So that the sinking of a heavy Body under Water is owing to a two fold Cause, viz. The *Weight of the Body*, and *that of the Water* above it.—So adieu, for this time, my *Euphrosyne*.

DIALOGUE IX.

The Phænomena of the TIDES, or FLUX and REFLUX of the Sea, explained.

Cleonicus.

THESE *Hydrostatical Speculations* have brought us at length, my *Euphrosyne*, to the Contemplation of that most wonderful Phænomenon of Nature, the FLUX and REFLUX of the Ocean, or the TIDES, as we usually call them.—Though the natural State of Fluids, in small Quantities, be that of *Rest*, this is far from being the Case with large *Seas* and *Oceans of Waters*, like those upon the Surface of our Earth, as they are exposed to the Attracting Powers of large Bodies that are near to them, in a very sensible Degree.

Euphros. This is a *sublime Subject* indeed, *Cleonicus*.—How will you be able to bring it down to the Level of a
Woman's

Woman's Understanding, when I have heard you say often, *That the Theory of the Tides was one of the greatest Discoveries of, and an arduous Task to demonstrate, even to the immortal* SIR ISAAC NEWTON.

Cleon. But one Comfort is, that neither my *Euphrosyne* nor myself are obliged to understand all that that great Man wrote.—*Half a Loaf is better than no Bread.*—Our Duty is to understand all that we can.—If we have but 3 Talents, no more will be required.—Consider, that NEWTON himself did not understand every thing—Omniscience is not a human Attribute.—Let us therefore be content, and endeavour to know all we can; and we shall stand excused for the rest.—The general Rationale of the Tides is not so difficult, perhaps, as you may fear, after so much as you have learned of the Powers of Attraction, and the Laws of Motion and Action in Fluids.

Euphros. Well, *Cleonicus*, I shall listen with great Attention to all you have to say on so elevated a Subject.

Cleon. To facilitate the Ideas of the different *Phænomena* of the Tides, I shall suppose the Earth to be covered all over with Water to a great Depth.—And further, that no other Body affected the Water by any Power of Attraction but the Earth alone.—Then it is evident, since the Water is every where *equally attracted* by the Globe of the Earth, it will be every where *equally heavy*; and consequently, the Surface of the said Water will be every where at an equal Distance from the Earth's Center, and so give a *truly Spherical Figure* to it.—Thus far at least, my *Euphrosyne* will understand me.

Euphros. I do perfectly well, *Cleonicus* —But since the latter Part of your Supposition does not hold good, what will the Consequence be, when this Spherical Surface of the Water becomes attracted, in a contrary Direction by Bodies exterior to, and at a various Distance from it?

Cleon. The general Effect of such an exterior Attraction, would be the Alteration of the *Spherical Surface* to that of an *Ellipsoide*, or Oval,—and the Water, from being in a State of *Equilibrium* or *Rest*, will be put into a *perpetual Motion*.—Now of all these exterior Bodies,
the

the Moon is the nearest to us, and her Magnitude is sufficient to afford an Attraction upon the Waters of the Earth, that shall very sensibly disturb their *Equilibrium*, give them *Motion*, and alter the Figure from a *Globular* to an *Oval* one.

Euphros. The Reason of what you say is extremely evident, from the huge Bulk of the Moon, which I remember you told me was 2000 Miles in Diameter.—Also the very *Tide itself*, as it consists of *Water in Motion*, plainly acknowledges a foreign Cause.—But pray *Cleonicus*, has it been determined to what Height the Moon can raise the Water of the Ocean by her opposite Attraction?

Cleon. It has been found by *Theory* and *Experiment* both, that the Moon raises the Water in the *Tide* to the Height of $11\frac{1}{2}$ Feet, at a Mean, above the Level of the Globe.

Euphros. You astonish me, *Cleonicus*, what is that Height compared to the Bulk or Diameter of the Earth!—I thought it had been 1000 times as much, at least.—Why this can be sensible only to us *small Animals* crawling upon the Surface of the Globe!—Your saying, “*by the Moon alone*,” implies some *other Agent* is concerned with her in producing the *Tide*; this I suppose, can be no other than the *SUN*; for though *Mercury* and *Venus* be near to us, yet their Distances are too great, and their Bulks too small, to be sensible Agents in producing the *Flux and Reflux* of the Sea.

Cleon. My *Euphrosyne* reasons well.—The *Sun* only can add any Influence to that of the Moon, for raising the Waters of the Ocean, and that is solely owing to his enormous Bulk.—But at present it will be proper to consider the Effect of the Moon by itself.—In order to this, I shall divide the Aqueous Surface into two Hemispheres by a great Circle, which may be called the *Lunar Horizon*.—The Water in the Hemisphere next the Moon will be attracted by it from the Earth's Center every where, with a Force greater and greater, till you come to the Point just under the Moon, where it will be greatest of all.—In this Hemisphere therefore, the Water will be lighter than if there were no Moon, because

now

now their Weight results from the *Difference between the Attracting Powers of the Earth and Moon*, and this Difference being greatest in the Parts under the Moon, the Water will be there the lightest of all, and therefore will rise the highest, and produce there the *Tide of Flood*.—But there is yet *another Tide of Flood* produced at the same time in the farther Hemisphere, and at the farthest Point thereof, or that which is diametrically opposite to the Moon.—For in all this Hemisphere, the Water is attracted by the Moon towards itself, and consequently in some measure towards the Center of the Earth.—Therefore, as both the Attractions now *conspire*, they will, by their *joint Force*, make the Water every where in that Hemisphere *lighter* than they would be if there was no Moon.—But because the Moon's Attraction is less where the Distance is greater, so, of Course, the Point opposite the Moon, as being farthest distant, will be least of all affected by the Moon; and there the *Sum of the two Attractions being least of all*, the Waters will become lightest, and rise to a *Tide of Flood*, as before.

Euphros. You have given a very clear Explication of the *Tides of Flood*, *Cleonicus*; and I suppose you will next do the like for the *Tides of Ebb*.

Cleon. Properly speaking, my *Euphrosyne*, there are no Tides of Ebb at all.—Under the *Lunar Horizon*, the Waters all around the Aqueous Surface are attracted by the Earth only, as the Moon's Attraction upon them there amounts to nothing.—They will therefore be just as heavy as if there was no Moon at all.—Consequently their Altitude from the Earth's Center is not altered in that respect at least, from what it was in the Sphere.—But in another respect, that Altitude in the Sphere will be lessened, and that is, because the Waters from this Part all round the Globe, must flow into each Hemisphere to supply and support the *Tide of Flood*, in order to an *Equilibrium* of the whole.—Hence in all Parts under and near the *Lunar Horizon*, the Water will subside, and become lower or nearer the Earth's Center, than when they formed a Spherical Surface, and were attracted by the Earth alone.—This *Low Water* it is that is called the *Tide of Ebb*, in every Place under whose Meridian it passes,

passes, in the Course of the Earth's Revolution about its Axis.—Thus an Aqueous *Spheroid* (or *Oval*) is formed whose *longer Axis* passes through the two greatest *Tides of Flood*, and is directed to the Moon; the shortest one passes through the Lunar Horizon at the Distance of 90 Degrees every where.

Euphros. I believe I comprehend all you have said in regard to *Low Water* also.—I therefore am satisfied the true Figure of such a Body of *Fluid Matter*, must be that you have mentioned, a *Spheroid*.—You have hitherto considered the Nature of the Tides in a general View; but I suppose they have a great Variety of Phænomena with respect to different Parts of the Earth, various Positions of the Moon, and the influence of the other Luminary, the Sun.—If you give me a short Account of these *Cleonicus*, it is all I shall ask of you at present.

Cleon. I shall endeavour to do that for my *Euphrosyne*, and there is much about time for it.—For this Purpose, you see here a Terrestrial Globe, with a small Ivory Ball fixed aloft above it, just in the Zenith.—Now this Ball represents the Moon, and the Horizon of the Globe then becomes the *Lunar Horizon at Low Water*.—And thus by elevating and depressing the Globe, all the considerable Appearances of the Tides will become obvious to your View.—In the first Place, let us suppose the Moon to be posited just over the Pole of the World.—Then the Equator is to be placed in the Horizon, and is the Circle of *Low Water*, the two Points of *High Water* being exactly over the Poles.—In this Case, it is evident as the Earth revolves, every Part describes a Parallel to the Equator, or *Lunar Horizon*.—Therefore has the Water always of the same Height—Consequently *no Tides of any Sort* could happen in any Part of the Earth, in such a Situation of the Moon.—Now in the second Place, let us suppose the Moon to be posited in the *Equator*, then are the Poles in the Horizon, or Circle of *low Water*.—And since in this Case all the Parallels of Latitude are perpendicular to the Horizon, therefore every Place will be *Six Hours* in passing from one Tide to another, as you well know by what you learned of the Use of the Globe heretofore.—Thirdly, suppose the Moon has the greatest Declination from the Equator she can have, which is not

quite 30 Degrees.—Then the Parallel of 60° on each Side the Equator, will limit the Places which have *two*, and *four Tides*, in 2 Day.—For all the Places about the North Pole to the Parallel of 60° will be in the Northern Half of the Spheroid, and as much about the South Pole, in the Southern Half of the Spheroid; and consequently they can have but one *Tide of Flood*, and one *Tide of Ebb* at the Distance of 12 Hours each.—But in all Parts of the Earth between the Parallels of 60 Degrees, as they must descend below the Horizon or Circle of Ebb on one Side, and rise above it on the other, so they must have 4 Tides, *two of Flood*, and *two of Ebb*, which will succeed each other in different Intervals of time, according to the various Latitudes of Places.

Euphros. Having learnt the *Use of the Globes*, I see all that concerns the Explication of the Tides very clearly.—And I hope I shall have no reason to despond of apprehending what Alterations will be made in these *Lunar Phenomena* of the Tides, by their being conjoined with the Effects of the Sun, *Cleonicus*.

Cleon. There can be no difficulty attending that Matter; my *Euphrosyne* can easily conceive, that at the *Conjunction* of the Sun and Moon, their joint Attraction of the Waters from the Earth, will make them lighter than before, and they will therefore stand higher, or make, a *greater Tide of Flood*.—On the other hand, at the *Opposition* of the Sun and Moon, the Sun attracts the Waters of the Spheroid in a Direction contrary to that of the Earth and Moon; and thereby makes that *Tide of High Water* also greater.—For the *Quadratures*, the Action of the Sun is contrary to that of the Earth only, and makes the Waters lighter in all the *Lunar Horizon*; consequently they will *rise higher* than before; and then, to keep the *Equilibrium*, they must subside, in a small Degree from the *Floods* at each End of the Spheroid, and so make those Tides less than they were by the Moon alone.

Euphros. I think every Article is so naturally described and pointed out, that I cannot well help forming a true Idea of the *Tides* both of *Flood and Ebb*, in this general View of them.—But I suppose, *Cleonicus*, that as the Distance of the Luminaries from the Earth are always variable, that must make some Difference in the Magnitude or Height of the Tides; pray is this at all sensible?

Cleon.

Cleon. Considerably so, my *Euphrosyne*; for the Sun in its *Perihelion* in the *Winter*, conjoined with the Moon in her *Perigee*, will cause the Waters of the Spheroid to rise higher by a more powerful Attraction of them from the Earth, and the same Effect will be produced at the *Opposition*.—In the *Quadratures* there is not much difference on this Account of their near *Distance*.—In the *Summer time* when the Sun being in its *Aphelion*, and the Moon in her *Apogee*, the Tides are the least they can be at any time.—On the contrary, when the Luminaries are in the Equator, and the Moon in *Perigee* at the *Syzygies*, the *Tides of Flood and Ebb* will be the greatest of all others.—And these *Equinoctial Tides* are what we vulgarly call the *Spring Tides*.—With respect to the time of the Tide's being upon the Meridian, it is to be considered, that though the Force of the Moon be greatest to raise the Water when she is upon the Meridian, yet that Force is continued a little while after it is impressed, and encreased by what is impressed sometime after the Moon has passed the Meridian; the Sum total, therefore, of all the impressed Force will cause the *highest Water* to follow the Appulse of the Moon to the Meridian at the Interval of about two Hours.

Euphros. All this, too, I understand tolerably well, *Cleonicus*.—But as these general Affections of the Tides are all upon Supposition that the Earth is all around covered with deep Waters, I imagine that in the present State of the Earth, there will be scarce any Resemblance between them and the Tides we observe in our confined Oceans and Seas, by reason of the Interposition of so many *Continents, Islands, &c.*

Cleon. A great part of the Earth is covered with Oceans of Water, particularly the *Great Pacific OCEAN* overwhelms more than one Quarter of it; in this the general Phænomena of the Tides are observed by *Navigators* to correspond with those pointed out by the Theory.—But in the smaller *Oceans, Seas, Bays, Rivers, &c.* what my *Euphrosyne* has observed, is found true, in regard to the Quantity, the Intervals of Time, and Direction of their Courses.—But in any one Place, as *LONDON* for Instance, they are so far constant and regular, that *Tables of HIGH WATER*, for Morning and Afternoon are calculated to *Hours and Minutes, for every Day in the Year.*

DIALOGUE X.

Of the various METAMORPHOSES or TRANSMUTATIONS of SOLIDS into FLUIDS, and FLUIDS into SOLIDS. Particularly of SILVER into a transparent FLUID.—Into CRYSTALS—Into an impalpable Powder—Into the Arbor Dianæ, or the Arborefcent VEGETATIONS in FORMS of SHRUBS, TREES, &c.—How rendered of a Golden COLOUR and permanent on GLASS. A SOLUTION of GOLD.—The CRYSTALS of GOLD beautifully displayed upon GLASS for Microscopic VIEWS.

Cleonicus.

WE are now, my *Euphrosyne*, entering upon *Scenes of Action* not common to Vulgar Eyes.—Herein we shall view the METAMORPHOSES or TRANSMUTATION of Bodies from one Form to another, in diverse Instances, by OMNIPOTENCE operating in the small Parts of Matter, by which, when they come into contact, and mix with each other, they immediately become altered and variously changed in their *Modes of Existence*.—*Ovid's Metamorphoses* were fictitious and merely poetical; mine are strictly philosophical and real; I think therefore his INVOCATION (a little altered) will stand with more Propriety before such Transmutations than his own.

*Of Bodies changed to various Forms I sing:
Assist ye Gods (from whom such Wonders spring)
Inspire my Numbers with Celestial Heat;
Till I my long laborious Work compleat:
And add perpetual Tenour to my Lays,
Deſcend from Nature's Birth to George's Days.*

Euphros.

Euphros. I know not what the *End* of this Dialogue may produce; but the *Beginning*, (my dear *Cleonicus*,) is so *solemn*, that I begin to be very apprehensive for my Understanding.

Cleon. In truth, my *Euphrosyne*, you need not; for perhaps not a Dialogue has come upon the Carpet wherein your Understanding has been less concerned than in the present.—Philosophy, such as I teach, does not consist so much in the Knowledge and Understanding of the Powers and Operations of Natural Bodies, in their various *Mixtures and Combinations*, as in making proper Observations on them, and reducing them to the *literary, religious, moral, and Commercial Uses of Life*.—CHEMISTRY is a most curious Part of Natural Philosophy, but perhaps the *Rationale* of the Operations is the most recondite and inscrutable of all others.—In this Lecture you will see nothing that is terrifying or noxious; nothing but what will fill your Mind with Admiration, Instruction and Pleasure.

Euphros. Well, I am glad, *Cleonicus*, you give so encouraging an Idea of the present Entertainment.—But pray what are these *Metamorphoses* to consist in, I want to know.

Cleon. In changing *Solids* to *Fluids*, and *Fluids* to *Solids*.—*Opaque Bodies* to *Transparent Ones*, and *vice versa*.—*Visible* to *invisible Ones*, and the contrary.—From *one Shape* to many other *Shapes and Forms*.—A rude and indigested Mass to curious and regular Figures.—From an *inert State* to an *active and vegetative one*.—With many other like Incidents at the same time.—And will not such Themes as these afford my *Euphrosyne* the most curious Speculations for an Hour?

Euphros. Most certainly they will, and I long till you begin, *Cleonicus*.

Cleon. The first *Metamorphose* is that of *Solid Bodies* into *Fluid Ones*.—You see here, my *Euphrosyne* a Wine-Glass containing a very *clear limpid Fluid*.—Upon the Surface, I place a Piece of Leaf-Silver, which is visible only a Moment or two, and then disappears.

Euphros. Truly so it does—pray what is become of it,

Cleonicus?—I see nothing in the Fluid, nor any thing evaporate from it.——

Cleon. It is dissolved in that *Menstruum*, which has a Power you see to separate the Parts of the Silver, and to absorb or attract them, and thereby suspend them through its whole Body.——For my *Euphrosyne*, by looking at it, will see the Fluid changed, in a small Degree, to a Milky Colour.

Euphros. I observe it——And am thereby convinced that the Silver is reduced to a *Fluid-State*, and intimately united with the *Menstruum*, as you call it.——But pray what is that odd Sort of Liquor, *Cleonicus*, that can thus silently and instantly change *solid Silver* into a *Fluid*?

Cleon. The CHEMISTS call it *Aqua fortis*, and distil it from *Vitriol and Nitre*.——It is an universal Dissolvent for almost all Sorts of Minerals and Metals, but *Gold* it will not touch,—this you will see by the Experiment,——I lay a Piece of *Leaf-Gold* upon its Surface, and you observe it does not in the least affect it.

Euphros. I see it does not—no Alteration is made in its Substance, nor even in its Colour.

Cleon. But now you'll see a *Transmutation* of one Fluid into another.——I change the *Aqua fortis* into *Aqua-regia*, by putting in only a Tea-Spoon full of *common Salt*.——And immediately the *Gold is dissolved*, and disappears, as the Silver had done before.

Euphros. Well this is wonderful indeed!—But pray, *Cleonicus*, what is this strange Effect owing to in the Salt?

Cleon. A thousand Conjectures have been formed for a Solution of this difficulty, but all hitherto in vain.——You see I put in Piece after Piece, which are presently dissolved, and giving the *Aqua regia* a beautiful Yellow Colour, plainly shews the *Gold is transmuted* into a *Fluid*, still as transparent as before.

Euphros. All wonderful, and surprising, to see *Gold* and *Silver* as it were annihilated, and vanish in a Moment!—Pray *Cleonicus* what do you metamorphose next?

Cleon. By the Mixture of two transparent Fluids, which you here see in two several Glasses, an opaque solid Body will be produced.——I pour one into the other, and
you

you see a White Turbid Mixture appears.—I now stir them together briskly, and behold an *Opake Lump of Matter* upon the *Spatula*, adhering thereto.—At present it is soft and adhesive, like *Shoe-Maker's Wax*.—When the Mixture is pressed and dried out, it becomes hard and transparent as *Amber*, and much resembles it.—Here view a Piece of it made some Months ago for this Purpose.

Euphros. I not only see it, but I smell it, *Cleonicus*.—It is some Sort of Gum or Rosin I am sure.—Pray tell me what you call those two Liquors?

Cleon. One is *Varnish*, and the other common *Water*, which I put into it.—The *Solid* resulting from this Mixture is the *Rosin* that was dissolved in *Spirit of Wine* to make the *Varnish*.

Euphros. I protest this Operation of yours a good deal resembles our Process of making *Butter* and *Cheese* in the *Dairy Room*; and I observe you have something like *Butter-Milk* or *Whey* left in the Glass, *Cleonicus*.—

Cleon. Not only the *Phænomena* but the *Rationale* of all such Processes are much the same.—The Particles of the dissolving *Medium* attract those of the Solid more powerfully than they attract each other; of Course they are separated, or the Body is dissolved.—But when another Fluid (or Solid) is mixed with that *Medium*, that is more attracted by it than the Particles of the Body dissolved; then those Particles being at liberty, return to their pristine State, by their proper Attraction; and is then, by the Chemists, said to be *regenerated*.

Euphros. I thank *Cleonicus* for so plain an Explication of this Chemical Principle of Philosophy.—Now please to proceed with your *Metamorphoses*.

Cleon. I shall by and by—But first my *Euphrosyne* must be acquainted with the Powers which Nature exerts in a much higher Degree to dissolve solid Masses of Metallic Bodies; those of *Leaf-Gold* and *Silver* requiring no sensible exertion of the *Medium* at all.—To this End, you see here a Four Ounce Vial nearly filled with *Aquafortis*.—Also, several small Pieces of *pure solid Silver*.—To encrease the dissolving Power, the *Aquafortis* has been already heated by the Kitchen Fire.—I shall therefore

now only place it upon the Trivet before this Fire for the Fumes to go up the Chimney—this done I put into the Vial a Piece of the Silver—it sinks to the Bottom.—And there behold Nature displaying her Power and Force upon it.

Euphros. Dear me, *Cleonicus*, with what Fury it is attacked by the Fluid!—What a rapid *Ebullition* of Particles of Air arise in a Torrent to the Top.—The Top of the Phial is filled with *Red Fumes* which fly up the Chimney.—I see the Piece of Silver is considerably diminished already.—I observe it moves about this way and that, forward and backward, as if it were alive.—I see it also rise up, and fall again.—It now rises quite to the Top, and it there swims round and round, boiling all the while.—The boiling decreases gradually.—It now quite ceases, no Silver is seen, but all is quiet as at first.

Cleon. This will be the Case with every Piece of Silver I drop in, till at last the Fluid will become so saturated therewith that it can dissolve no more.—This you will soon see; in the mean time I would observe to my *Euphrosyne*, that Pieces of *Copper, Iron, Lead, Tin, Mercury, &c.* are all dissolved in this manner by *Aqua fortis*; but it acts upon Iron with greater Violence than on any other Metal.—That the Quantity of Air discharged from the Silver is supposed to be the Cement or Principle which united all the Particles together in its Native State,—That the Fumes arising in such Plenty, are of a poisonous Nature; and when condensed, as you see, on the Rim of the Vial, appear like *White Arsenic*.—But hold, the Operation is now nearly finished.

Euphros. I observe it is by the Pieces swimming about on the Surface long before they can be dissolved.

Cleon. I'll now take it off, and set it in the Window to cool by degrees.—When it becomes colder, it cannot support so much Silver as now it is hot.—And what will afford you a most curious Sight, is, that the Particles of Silver will be crystalized by the Cold, and descend in *Broad Flakes* or *Crystals* to the Bottom of the Vial, and there appear like *Flakes of Snow* on the Ground.

Euphros. What a new and amazing Phænomenon is this! I see the *Flakes* forming in all Parts of the Body of the Fluid.—I see them descend promiscuously to the Bottom, just
as

as *Snow* descends in the Air.—A *Shower* of *Silver Snow* I little thought of ever seeing.—I even never heard of such a thing before.—The *Shower* still continues, and the *Crystals* rise higher and higher at the *Bottom*.—They are perfectly pellucid, and by their angular and indented Edges promise to make a *curious View* in the Microscope.

Cleon. The *Shower* is now over, my *Euphrosyne*.—The *Liquor* is become cold, nearly.—I pour it off into another *Vial*,—and then gently shake out the *Silver Snow*, or solid *Crystals* upon a Piece of soft Paper, which soon absorbs all the Moisture.—And you see they are now dry, and separable one from another.—One of these I place under the Microscope for your Inspection; look at it.—

Euphros. I see it very plainly, and a curious Object it is.—But I know not how to describe its Form, consisting of so many Lines, Angles, Indentures, Points, &c.—Upon the whole, I am thoroughly convinced, that those delightfully variegated *Crystals* exhibit a noble and singular *Metamorphosis* of *Silver*.

Cleon. I shall put them into this small Box for your *Museum*, where they will keep good for Years.—And after a time, when you open the Box, not only *Crystals*, but a *Solid Mass* of pure *Silver* will be regenerated from them.—Such a Piece I here shew you in the Microscope also—look at it my *Euphrosyne*.

Euphros. I do, and see a most curious Appearance of solid massy *Silver*, like a very small *Brain-Stone* on the Surface.—Why this, *Cleonicus*, is a *Metamorphosing Crystals* again into their native State, *SILVER*.

Cleon. And *SILVER* of such a Production, you may challenge any *Chemist* in *LONDON* to shew you.—The next *Metamorphosis* of *Silver* is into a fine *POWDER*.—You observe I put a clean *Brass Wire* into this *Vial* of dissolved *Silver*, and let it stand a few Seconds—Then behold the Effect, my *Euphrosyne*.

Euphros. I do, *Cleonicus*,—I see something gathering all round the Wire, from Top to Bottom of the Fluid—it appears in the form of Powder—The Wire seems to attract it from the Fluid, and becomes every Moment bigger

ger and bigger—It is now more than an Inch thick—It begins to fall off, and sinks down in form of a Brown Powder or Dust at the Bottom.

Cleon. When I shake the Wire it all falls off and sinks to the Bottom. ——— I shall now pour off the Liquor into another Phial——And the Powder into a Tea-Saucer to dry,——When it will appear as you see it in this small Vial, which I have brought for your Use.

Euphros. And pray what Use am I to make of it, *Cleonicus*?

Cleon. You may *metamorphose* a Piece of *Brass* into *Silver* in appearance.——My *Euphrosyne* will observe the Experiment,—Here is a slip of *Brass* well polished,—Then I strew some of the Powder upon it, and rub it into the *Brass* by a Piece of *Cork* dipped in *Salt*—and then the *Brass*, being cleaned, appears all over as *White as Snow*—That is, it has now a real *Silver Surface*.

Euphros. Why this is not only a very delicate, but I should think, a very lucrative Experiment, *Cleonicus*.——Could you not convert a *Brass Candlestick* into a *Silver One* in the same Manner?

Cleon. Yes, and I actually have done it, and used it for Years, without Suspicion of its being any thing but Plate.——After a like Manner *Clock-makers silver the Dial-Plates* of their Clocks, *Barometer-Plates*, &c.

Euphros. This is a most useful Part of Philosophy indeed.——I shall every now and then amuse myself with this Powder.——But what is your next *Transmutation*, *Cleonicus*?

Cleon. One that will highly delight my *Euphrosyne*, I am sure, because it pleases every One.—It is, in short, producing from this Solution of *Silver*, the most curious *Vegetation* of solid *Silver* imaginable.—This is what *Chemists* call *Arbor Dianæ*, or *Diana's Tree*.

Euphros. I am impatient to see this wondrous Experiment, *Cleonicus*.

Cleon. It is immediately performed thus—I take a small quantity of the Solution, and spread it upon this slip of *Glais*, as you see.——I then put into the middle of it,

a small Piece of Brass as big as a fine Pin's Head.—
And now, with your *Explorer*, observe the Effect my
Euphrosyne.

Euphros. I do, and a most wonderful one it is.—I see
a Vegetation begin, and constantly encrease from, and all
around the Brass.—I observe also that it begins in large
broad Flakes, or Leaves of the purest *shining Silver*, ex-
ceeding any artificial Polish whatever.—These are bor-
dered all around with the most curious and delicate *Ra-*
mification and *Branchery of Silver Sprigs* my Eyes ever
beheld.—'Tis amazing to see how long, how slender,
how wide they spread every Way.—They now fill a Cir-
cle of more than an *Inch diameter*.—And yet continue
to go on, and divaricate into smaller and finer Branches.—
Where will this *metalline Vegetation* end!—

Cleon. It will end at last in such minute and impercep-
tible Branchery, that requires a Microscope to exhibit a
distinct View of it.—Indeed you may thus make them, and
keep them by you for Years.—But because they are rub-
bed off with the Touch, I shall render them permanent
and indelible upon the Glass for ever.—But first I will
shew my *Euphrosyne* how she may make SHRUBS and TREES
in SILVER and GOLD at Pleasure, with as much Ease as
Diana herself.

Euphros. Why it seems as if you designed I should emu-
late a Goddess, *Cleonicus*.

Cleon. You shall do more—You shall do what none of
their *Godships* could do.—This Slip of Glass is 2 Inches
long, and an Inch wide, over one half I spread the silver
Liquor—Then lay the small bit of Brass in the lowest
part, and you see it vegetate into beautiful *Shrubs* imme-
diately.—Then with my Pencil I draw a fluid Stroke
from the Shrub to the lower Part of the Glass for the
Body of a Tree.—And now I draw a Stroke across the
Glass at the Bottom for the Ground—Then shaking a
few fine Brass Filings over the Body and Ground, you
observe a compleat Silver Tree is thereby formed.

Euphros. This I must say is the finest Effect of Art I
have ever seen, to please me.—But I think *Cleonicus* said
he could render it permanent, and make it look like
Gold.

Cleon.

Cleon. This will be the last *Metamorphosis* at present.—To do this, I only put the Slip of Glass on another of Brasses—This I hold in the Coal Fire till it becomes red hot—Then taking it out and cleaning it—Behold, your *Silver Tree* converted to *One of Gold*.

Euphros. Surprisingly fine sure enough!

Cleon. In this Manner you may raise *Groves of Silver Trees* to Diana,—and others of *Gold to Pomona*.—In many of these *Trees* my *Euphrosyne* will sometimes see every *Branch and Twig laden with Fruit*.—So much for *Silver*.

Euphros. And a great deal more than I ever expected to know of it.—Pray *Cleonicus* does any other Metals *crystallize* and *vegetate* as *Silver* does?

Cleon. They most of them shoot into *Crystals*, but none produce those curious *Arborescent Vegetations* but *Silver*.—The *Crystals of Copper* are very common, and of a beautiful *Blue*; as you see in the bottom of this Vial containing a *Solution* thereof.---Here is another of *Iron dissolved*, with *Green Crystals*, or *Vitriol*.---Lastly, here is another *Solution of Mercury*, as clear and limpid as *Water* itself, but no *Crystals* there.---If I put a *Brass Wire* into it, you see it comes out as *White as Snow* by the *Mercury* which it attracts.---If an *Iron Wire* made bright be put into the *Copper Solution*, it is changed in Appearance, to *Copper*, by being lined therewith.---And now to conclude, I shall place under the *Microscope* some *Crystals of Gold*, which perhaps you will no where else see.---Look at them.

Euphros. I do, and very fine they are---different from any Sort of *Crystals* I have yet seen---they are perfectly transparent, and of their native *Yellow Colour*.---A great *Curiosity* indeed.

DIALOGUE

DIALOGUE XI.

*Of the PRINCIPLES of Mechanical PHILOSOPHY.
Of POWER or FORCE arising from GRAVITY and
VELOCITY of MOTION. Of the two simple Me-
chanical POWERS, the LEVER, and the inclined
PLANE. Of the PULLEY, WHEEL and AXLE,
WEDGE, and SCREW. Of the BALLANCE, and
STEELYARD.*

Cleonicus.

AS the Modern (the only true,) PHILOSOPHY is usually said to be *Mechanical* it will be necessary for my *Euphrosyne* to understand the NATURE and PRINCIPLES of *Mechanic SCIENCE*, which has for its object the Consideration of the Modes and Means by which Natural Bodies affect or act upon each other, with the Forces they are endowed withal,

Euphros. I must desire *Cleonicus* to be a little more explicit, or else I fear these abstruse Subjects will remain so to me; for at present I have scarce any *Idea* of what you call *Mechanical*.

Cleon. I don't know how you should, my *Euphrosyne*. It is my Happiness however, to believe that you will find no more Difficulty in this than you have done in any other Part of Philosophy,—For Instance, where is the Difficulty of Understanding that any Effect is properly said to be *Mechanical* that is produced by Means of any Sort of *Machine, Engine, or Instrument* whatever?

Euphros. None at all, *Cleonicus*, if that be all you mean.

Cleon. No more is meant, when we say the Force of Wind upon the Sails, of Water upon the Float-Boards, of Fluids upon Solids immersed, and Solids upon Fluids, &c. &c. is altogether *Mechanical*, that is, they Produce an Effect in Proportion to the Surface they have to act upon.—

The

The Effects produced by any Kind of *Machinery* are said to be *Mechanical*.—And *Mechanical Powers* mean only such Machines by which we are enabled to *raise, move, or manage* such Bodies as exceed human Strength by their Resistance.—And we are furnished by Nature with two Principles, by which the *greatest Force may be overcome by the least Power applied for that Purpose*.

Euphros. Why this is as great a *Paradox in Mechanics*, as you shewed me in *Hydrostatics, Cleonicus*.

Cleon. It is equally so, my *Euphrosyne*.—Nor will you wonder (when you have made a small Proficiency in these Studies) that with a *single Horse-Hair* you will be able to raise a *hundred thousand Pound Weight* from the Ground, and as much more as you please.

Euphros. I long, *Cleonicus*, to be instructed in the Nature of those PRINCIPLES by which we are enabled to perform such wonderful Feats.

Cleon. These PRINCIPLES or *Natural Powers* are of two Sorts.—The first is that which arises from the Weight or Gravity of Bodies.—The second is from their *Motion*, or rather from the *Velocity of that Motion*.—For the Power effected by Motion is always proportionable to the Velocity thereof, and the *Quantity of Matter* in the moving Body,—And both these together make the whole Force or Effect that any Body can possibly have, and is usually called its *Momentum*.

Euphros. Then if I understand you right, a Body at rest has but one Force, which is that of its *Weight or Pressure*, which undoubtedly must be in proportion to its *Quantity or Mass of Matter*.—But if it moves, it acquires another Force from its *Swiftness of Motion*.—And that both these united make the whole Force of the Body, to make, or to overcome any Resistance.—Am I so far right, *Cleonicus*?

Cleon. Quite so, my *Euphrosyne*.—In less than Half an Hour you are half a *Mechanic*.—As you have so good an Idea of *Mechanic Principles*, the Nature and Construction of *Mechanical Powers* will follow with ease.—For these *Powers or Machines* are but two in Number, and of so simple a Form that you no sooner see them, but you must

see

see their Uses also—Especially by an Experiment or two on each.

Euphros. And pray what do you call those two *Mechanical Powers*?

Cleon. The first is called a LEVER, and the second an *inclined PLANE*.—Both these I shall now place upon the Table before you—And proceed to explain the Nature of each, and confirm every Thing I say by Experiments.

Euphros. I see them—and they appear simple enough, I am sure.—For me, who presumed to learn the Use of *Globes, Orreries, Fire-Engines, &c.* to have any misgivings about these little Things, would be a Shame, indeed, *Cleonicus*.—Therefore please to proceed.

Cleon. I need not tell my *Euphrosyne* what a *Plane* is.—But it will be proper to observe here, that a Plane intended for a Mechanical Power, must be considered as perfectly smooth, that it may give no Resistance to the Body that is moveable upon it—and that this Plane may be placed in three different Positions, *Horizontal, Perpendicular, and Inclined*.—Now this Plane becomes a *Mechanical Power*, by lessening the Weight of a heavy Body upon the Hand, when laid upon it, with Intent to move it, or raise it upwards.—The Surface of the Body is also supposed to be quite smooth, and the more of a *cylindric Form* the better.—Such a *Plane*, and such a *Cylindric Body*, you here see in Brass upon the Table.—I now place the Cylinder upon the Plane, and it presses it with all its Weight perpendicularly downwards.—The Plane, by its equal reaction upwards, destroys all that Force of Pressure—Consequently, no Weight at all remains in the Body.—It is therefore now *absolutely light*.—And this being the Case of all Bodies, be their Weight ever so great, it follows, that the heaviest Body on a *Horizontal Plane* is divested of all its Weight upon the Hand, and is therefore moveable upon that Plane by the least conceivable Force applied to it.—Only put your Finger to it, and try the Experiment.

Euphros. I do so, and find as you say, that it is perfectly free to move.—I scarcely touch it, but it rolls along.—By your Reasoning, and by the Experiment both, I am thoroughly convinced of the great Mechanical Effect that might be produced by this *Horizontal Plane*, if one could be

be had that would give no Resistance to the Motion of Bodies upon it, from the *Asperity* of its Surface.

Cleon. Though no such can be had, yet as the Case now stands, the Use of *Rolling Cylinders* is very great, witness those large and heavy ones of *Stone* and *Iron* for *Gravel Walks* in *Gardens*—and those of *Timber* for the *Farmers* Use.—But this *Horizontal Plane*, my *Euphrosyne*, will only avail us in *Horizontal Motions*; when we want to raise a very heavy Body *upwards*, we must use the *Inclined Plane*, which is more or less elevated above the *Horizontal Level*.—Such a one I have here placed before you, to try Experiments upon.

Euphros. It seems to be a very elegant and curious Machine indeed.—Pleased I shall be to see *Cleonicus* explain the *Nature* and *Use* of it to me.

Cleon. The *PLANE* is 9 Inches long, and moves up and down upon its Base by a *nice Joint* at the End.—It is elevated to any Angle at pleasure above the *Horizon*, by a strong *Brass Arch* of a Circle.—On this Arch are engraven the *Degrees* to 60—Also the *Number of Inches* which measure the *Height of the Plane* for any of those *Degrees of Elevation*.—When the Plane is elevated to a proposed Height, it is there fastened by a *Screw* to the Arch very firmly.—Upon the Top of the Plane is fixed a *Pully*—The *Cylinder* is moveable in a *small Frame*, in the middle of which is fixed a *String*, with a *Hook* at the End to hold a small *Weight*.—Lastly, the Plane, (for shewing Experiments) is placed upon the Top of the *Brass Pillar* or *Pedestal* you there see.

Euphros. But what are the Experiments on this *Inclined Plane* to prove, *Cleonicus*?

Cleon. They are to prove the Truth of this *Mechanical Thesis*,—That the whole *Weight* of a Body is to that which remains upon the *Hand*, when laid upon the Plane, as the *Length of the Plane* to its *Height*.—And this you will see verified by Experience.—This *Brass Cylinder* with its *small Frame*, weighs just 3 Ounces—The Plane is elevated to the Height of 3 Inches, which is $\frac{1}{3}$ of the Length of the Plane,—Therefore, by the foregoing Proposition, we have, As the Length 9 is to the Height 3, so is the whole Weight of the Cylinder 3 Ounces, to the residual Weight 1 Ounce.—

Ounce—And this you see proved by the Experiment.—For I place the Cylinder on the Plane, and hang the String over the Pulley, with a single Ounce Weight at the End—And the Effect is, *a perfect Equilibrium between the Weight and the Cylinder.*

Euphros. I see the whole Tenour of the Experiment most evidently, *Cleonicus.*—For since *One Ounce* acting against the Cylinder, ballances it, the *Force in it to descend* can be equal to *One Ounce only.*—And hence I see the Cylinder looses full *two thirds* of its Weight when laid on the Plain thus elevated.

Cleon. And by a Parity of Reason, if the Plane were elevated to but a *Tenth Part* of its Length, then only one tenth of the Weight of a Body would remain, when laid on *such a Plane.*—Hence if the Body weighed 100 Weight, a Force of little more than 10 Pounds would raise it up the Plane.—If it weighed 1000 Weight, 900 would be supported by the Plane, and one Man could raise such a Body upon it.—Hence it is that in Practice you frequently see very heavy Bodies raised from the Ground; up into the *Tail of a Waggon.*—Or, still higher, into Store-Houses from all the Wharfs and Quays about London, by means of *very strong inclined Planes.*

Euphros. These great Operations I have often observed; but I never knew the *Reason*, or rather, the *Philosophy* of them before now.—Well the *Inclined Plane* is a most useful *Mechanical Power*, and that to a prodigious degree.—And now *Cleonicus* will explain to me the other *Power* he called the *LEVER.*

Cleon. The *LEVER* is supposed to be an inflexible long Rod, without Weight, moveable upon a *Fulcrum* or Prop placed near one End.—This divides it into two unequal Parts or Arms—upon the *shortest* of which a *heavy Body* is placed.—And at the End of the longer Arm, a *Power* is applied to raise it.—But to make all this easier, I have here provided a *Lever* in Miniature, which will explain the *Theory and Use* of this *Mechanical Power* as well as one ever so large.—It consists, you see, of a long flat Piece of Steel, moveable about a polished Steel Axle on the Top of a small *Brass Pillar.*—This Axle serves for a *Fulcrum*, or Supporter.—The longer Arm of the Lever

is 8 Inches, and the shorter, one and a half.—At the End of the shorter Arm is fixed a Piece of Brass to ballance the Weight of the longer Arm.—And thus the Lever is reduced to a *Horizontal Position*,—And being in *Equilibrio* with itself, may be considered as *without Weight*.—At one Inch distance from the Axle, or Center of Motion, a Notch is made upon the short Arm on which to hang any *heavy Body*.—And upon the longer Arm are Notches at every Inch distance, numbered 1, 2, 3, 4, &c. to 8.—Upon these a small Weight or *Power* is hung to ballance the *heavy Body* on the other Side of the Center.—And thus the *Lever* is accoutred for Use.

Euphros. You will please, then, now to shew me the Use and Design of this little Instrument, *Cleonicus*.

Cleon. That will all appear by the Experiment, which will demonstrate, *that the Force of a Body in Motion consists of the Quantity of Matter, and Velocity with which it moves*.—Thus, I hang 1 Ounce on the short Arm of the Lever, and 1 Ounce at No. 1 on the long Arm, and they ballance each other, because they have *equal Weight*, and they move with *equal Velocity* when they do move, being at the same distance from the Center.—But when I remove the Ounce upon the long Arm to No. 2, it will then be twice as far from the Center as the Weight is on the short Arm, and consequently will move twice as fast, when the Lever is moved; and since its *Velocity is double*, the *Force will be so too*; therefore it will preponderate the single Ounce Weight on the short Arm, and destroy the *Equilibre*.—This must now be restored by adding another Ounce to the former on the short Arm.—Thus 1 Ounce with twice the Velocity, is equal in Force to 2 Ounces with but half that Velocity.—The Power or Ounce on the long Arm being removed to No. 3, will acquire 3 times the Velocity, and will therefore equilibrate 3 Ounces on the short Arm.—At the distance of No. 4, it will sustain 4 Ounces—And at No. 5, it will be equivalent to 5 Ounces, and so on as far as my *Euphrosyne* pleases.

Euphros. An important Experiment is this, *Cleonicus*, truly—for by this I see that if a Man by placing his Hand at No. 1 can sustain or lift 100 Weight on the short Arm, he

he will by applying his Hand to No. 2, be able to lift 200 Weight.—At No. 3, he will lift 300 Weight and so on; which proves sufficiently the exceeding Usefulness of the *Lever* as a *Mechanical Power*—Pray what have you farther to observe of the *Lever*?

Cleon. Only this, that it is the Principle upon which every other *Machine* acts that encreases our Power by an encrease of Velocity of Motion.—Thus when you raise a Weight by a *Tackle* of PULLEYS, you acquire a Velocity to your Hand much greater than that of the Weight or Body you raise, and in that Degree it becomes a *Mechanical Power*.—There is also another Machine, which is a large WHEEL fixed upon an AXLE, for raising very heavy Bodies, which it does by encreasing the Velocity of the Power above that of the Weight in proportion as the Diameter of the Wheel is greater than that of the Axle; because the Power is by this Means applied at so much greater Distance from the Center of Motion, than the Weight upon the Axle.

Euphros. I see very plainly the Property of these Machines you mention, and the Principle on which they act.—But have I not heard of two other *Mechanical Powers*, *Cleonicus*, called the WEDGE and the SCREW?

Cleon. It is a common Notion that the Wedge is a *Mechanic Power*, and indeed so it is, as being an *Inclined Plane*.—But then the Force we receive from it, is nothing compared with that which we are to overcome when we use it, as in cleaving Logs, and raising very heavy Bodies by driving it into, or under them.—For the prodigious Force required for this End, is derived solely from the immense Momentum of the Stroke upon the Top of it from the BIT-TLE or SLEDGE, used in driving it in by repeated Strokes.

Euphros. It is no small Happiness those have who study Philosophy by obtaining a correct Notion of Things.—And how am I to conceive of the SCREW, *Cleonicus*?

Cleon. Not as a simple *Mechanical Power* my *Euphrosyne*, though it be defined to be an *Inclined Plane* coiled round a Cylinder.—For the Screw is never used without a *Lever*, or something analogous to it.—The common Screw-driver is a small Lever—And in raising Bodies of great Weight, or Resistance, a large and strong *Lever* is always used.

In all kinds of *Presses* for squeezing *Fruit*, *Cheese-Curds*, *Linen*, &c. the *Screw* is turned by a *double-handed Lever* generally, as you very well know.—The *Screw and Lever* make a *Compound Mechanical Power*, more universally useful than any other, to all Mankind concerned in *Machinery* of any Sort whatever.

Euphros. Pray, *Cleonicus*, are the *BALLANCE* and *STEELYARD* to be reckoned among the *Mechanical Powers*?

Cleon. Not the *Ballance*, my *Euphrosyne*, because the *Beam* thereof is only a *Lever* with two *equal Arms*, and so can give no *Power*.—The whole *Design* of this common *Instrument* is to find the *Weight* of a *Body* placed in one *Scale* by putting *known Weights* into the other, till they *equipoise* each other.—But the *Steelyard* is a direct *Lever* which finds the *Weight* of a *Body* hung on the short *Arm*, by a constant known *Weight* upon the longer one, moved to the Part where it makes an *Equipoise* by its *Velocity*, in every *Respect* the same as in the *Experiment* of the *Lever* you saw but now.

Euphros. I don't think of any other *Instrument* to enquire particularly about, *Cleonicus*; so will give you no further trouble at this *Time*.—

Cleon. Perhaps my *Euphrosyne*, does not think that the *Aw*, the *Chissel*, the *Knife*, and even her very *Scissors*, are really *Mechanical Powers*, as being truly *Inclined Planes* all of them; and many other *Implements* in *Common Life*, that will occasionally fall in her *Way* to consider at times—And as I think this *short Sketch* of *Mechanical PHILOSOPHY* was necessary, and will suffice for the present, so my *Dearest Euphrosyne*, Adieu.

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